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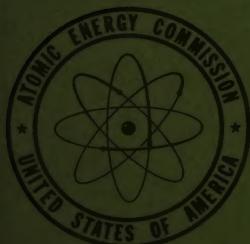
## Nuclear Science Abstracts

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## NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is issued twice monthly throughout the calendar year by the Atomic Energy Commission. It is intended primarily to serve scientists and engineers working within the Atomic Energy Project by abstracting as completely and as promptly as possible the literature of nuclear science and engineering. It covers not only the unclassified and declassified research reports of the Atomic Energy Commission and its contractors, but also material in its field of interest which appears in technical and scientific journals and unpublished research reports of government agencies, universities, and industrial research establishments.

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Nuclear Science Abstracts is fully indexed by author, subject, and report number. Annual index issues are prepared for each volume, and the next cumulated index will appear in volume 10(1956) covering volumes 5-10. A cumulated index to volumes 1-4 was issued as volume 4, No. 24B, Dec. 30, 1950 covering authors, subjects, nuclides, and report numbers. The 24th number of volumes 5 and 6 contain indexes covering the individual volumes and a completely cumulated Numerical Index of Reports.

Each issue of volume 7(1953) contains an author index to abstracts in that issue and a supplement to the Numerical Index of Reports. Subject and author indexes, as well as a cumulation of the Numerical Index of Reports, covering three-month periods are issued as supplements to the sixth, twelfth, and eighteenth issues. The 24th issue will be the annual index for the year, superseding the three index supplements mentioned above.

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## GUIDE TO ABSTRACT WRITING

1. *Purpose.* It is very important that a paper be accompanied by an abstract, preferably appearing at the beginning. This abstract is not part of the paper—it is an adjunct intended to convey briefly the content of the paper, to draw attention to all new information and to the main conclusions. It should be directly informative, not merely indicative.

2. *Style of Writing.* The abstract should be written concisely and in normal rather than abbreviated English. Where possible, standard terms should be used and unnecessary contracting should be avoided. The third person is preferable. Mixed tenses, and both indicative and imperative forms should be avoided.

It should be presumed that the reader has some knowledge of the subject, but has not read the paper. He may not even have the paper available at all, if he is working with the abstract journal only. The abstract should, therefore, be intelligible in itself, without reference to the paper; for example, it should not cite sections or illustrations as a substitute for a statement of their content.

3. *Content.* The title of the paper is usually read as part of the abstract, therefore repetition of the title in the opening sentence of the abstract should be avoided. If the title is insufficiently comprehensive to indicate the subjects covered or the objects of the investigation, the opening sentence should make this clear.

The abstract should state newly observed facts, conclusions of an experiment or argument and, if possible, the essential parts of any new theory, treatment, apparatus, technique, etc.

It should contain the names of any new compound, and any new numerical data, such as physical constants; if this is not possible it should draw attention to them. It is important to refer to new items and observations, even though they may be incidental to the main purpose of the paper.

When giving experimental results, the abstract should indicate the methods used; for new methods, the basic principle, range of operation, and degree of accuracy should be given.

4. *Detail of Layout.* It is impossible to recommend a standard length for an abstract. It should, however, be concise and should not normally exceed 200 words. References should be omitted from the abstract whenever possible.



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7-1863	KILPATRICK MARTIN	7-2059
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KATZENSTEIN HENRY S	7-2100	KRAUS KURT A
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KATZIN LEONARD I	7-3030	KRAUSHAAR J J
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REPORT	ABSTRACT	AVAILABILITY	REPORT	ABSTRACT	AVAILABILITY
AECD	NSA		AECU	NSA	
2720	3-2287	p.1267-82 in Mechanical Engineers Handbook, 5th Ed. L. S. Marks, ed. N. Y., McGraw Hill, 1951	146	2-1329	<u>Anal. Chem.</u> <u>22</u> , 837-8(1950)
			148	2-1337	NNES Div. VI, Vol. 1, Pt. III, Chap. 19
2769	4-1906	NNES Div. VI, Vol. 1, Pt. III, Chap. 18	149	2-1434	<u>J. Clin. Invest.</u> <u>28</u> , 746-51(1949)
2770	4-1908	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	422	3-1623	<u>Science</u> <u>111</u> , 117-18(1950)
2771	4-1909	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	667	4-1907	NNES Div. VI, Vol. 1, Pt. III, Chap. 19
2772	4-1910	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	668	4-1919	NNES Div. VI, Vol. 1, Pt. III, Chap. 21
2773	4-1911	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	670	4-1920	NNES Div. VI, Vol. 1, Pt. III, Chap. 21
2774	4-1912	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	673	4-1352	NNES Div. VI, Vol. 1, Pt. III, Chap. 21
2775	4-1913	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	744	4-1615	<u>Science</u> <u>111</u> , 655-7(1950)
2776	4-1914	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	746	4-3627	<u>Federation Proc.</u> <u>9</u> , 338(1950)
			748	4-3635	<u>Federation Proc.</u> <u>9</u> , 206(1950)
			1077	4-3581	<u>Federation Proc.</u> <u>9</u> , 334-5(1950)
2777	4-1915	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	1314	5-1440	p.49-51 in Americana Annual, John J. Smith, ed. N. Y., Americana Corp., 1952
2778	4-1916	NNES Div. VI, Vol. 1, Pt. III, Chap. 20	1565	5-4189	<u>Anais Acad. Brasil. Cienc.</u> <u>24</u> , 113-36(1952)
2779	4-1917	NNES Div. VI, Vol. 1, Pt. III, Chap. 21	1681	5-5344	<u>J. Applied Phys.</u> <u>23</u> , 1085-8(1952)
2780	4-1918	NNES Div. VI, Vol. 1, Pt. III, Chap. 21	1713	6-6578	<u>Cancer Research</u> <u>13</u> , 27-9(1953)
2783	4-1924	NNES Div. VI, Vol. 1, Pt. IV, Chap. 25	1855	6-3154	<u>Quart. Rev. Biol.</u> <u>26</u> , 348-63(1951)
2784	4-1925	NNES Div. VI, Vol. 1, Pt. IV, Chap. 26	1977	6-3610	<u>Rev. Sci. Instr.</u> <u>24</u> , 267-8(1953)
2785	4-1926	NNES Div. VI, Vol. 1, Pt. IV, Chap. 26	1988	6-3329	<u>Rev. Sci. Instr.</u> <u>24</u> , 1-4(1953)
2786	4-1927	NNES Div. VI, Vol. 1, Pt. IV, Chap. 26	1991	6-3154	<u>Rev. Sci. Instr.</u> <u>24</u> , 72-3(1953)
2787	4-1928	NNES Div. VI, Vol. 1, Pt. IV, Chap. 27	1996	6-3630	<u>Radiology</u> <u>60</u> , 421-4(1953)
2788	4-1929	NNES Div. VI, Vol. 1, Pt. IV, Chap. 28	2017	6-3711	<u>Rev. Sci. Instr.</u> <u>24</u> , 148-51(1953)
2789	4-1930	NNES Div. VI, Vol. 1, Pt. IV, Chap. 29	2021	6-3761	<u>Phys. Rev.</u> <u>89</u> , 919-22(1953)
2905	4-5843	<u>Am. J. Physiol.</u> <u>163</u> , 733-4(1950)	2026	6-3769	<u>J. Chem. Phys.</u> <u>20</u> , 1688-94(1952)
3080	5-3083	<u>Acta Cryst.</u> <u>6</u> , 269-72(1953)	2041	6-3744	<u>J. Phys. Chem.</u> <u>57</u> , 129-34(1953)
3227	5-5873	<u>Am. J. Phys.</u> <u>21</u> , 151-9(1953)	2061	6-3911	<u>J. Phys. Chem.</u> <u>56</u> , 877-81(1952)
3269	6-353	<u>Am. J. Phys.</u> <u>20</u> , 536-58(1952)	2079	6-4113	<u>Arch. Ind. Hyg. and Occupational Med.</u> <u>6</u> , 512-17(1952)
3323	6-2082	<u>J. Metals (N.Y.)</u> <u>5</u> , 545-8(1953)		6-4437	<u>Ind. Eng. Chem.</u> <u>45</u> , 1148-52(1953)
3343	6-2619	<u>Anal. Chem.</u> <u>25</u> , 226-30(1953)		6-4437	<u>Biochim. et Biophys. Acta</u> <u>9</u> , 597-600(1952)
3344	6-2874	<u>Anal. Chem.</u> <u>25</u> , 466-70(1953)		6-4341	<u>J. Immunol.</u> <u>70</u> , 135-40(1953)
3349	6-3280	<u>J. Am. Ceram. Soc.</u> <u>36</u> , 137-9(1953)		6-4551	<u>J. Chem. Phys.</u> <u>20</u> , 1670-2(1952)
3352	6-3445	\$0.25		6-4552	<u>J. Chem. Phys.</u> <u>20</u> , 1665-8(1952)
3363	6-3259	<u>J. Chem. Phys.</u> <u>21</u> , 542-4(1953)		6-4685	<u>Science</u> <u>117</u> , 280-2(1953)
3389	6-4520	<u>J. Applied Phys.</u> <u>24</u> , 44-8(1953)		6-4730	<u>Anal. Chem.</u> <u>25</u> , 350-1(1953)
3419	6-5238	<u>Rev. Sci. Instr.</u> <u>24</u> , 181(1953)		6-4849	<u>Rev. Sci. Instr.</u> <u>24</u> , 78-80(1953)
3421	6-5374	<u>J. Applied Phys.</u> <u>24</u> , 152-6(1953)		6-4711	<u>J. Invest. Dermatol.</u> <u>20</u> , 93-103(1953)
3433	6-5764	<u>J. Am. Chem. Soc.</u> <u>75</u> , 798-800(1953)		6-5037	<u>J. Biol. Chem.</u> <u>200</u> , 407-16(1953)
3436	6-5863	<u>Phys. Rev.</u> <u>90</u> , 102(1953)		6-5416	<u>Rev. Sci. Instr.</u> <u>24</u> , 75-6(1953) (Condensed version)
3438	6-5735	<u>Anal. Chem.</u> <u>25</u> , 644-5(1953)		6-5284	<u>Am. J. Botany</u> <u>39</u> , 679-84(1952)
3453	7-219	<u>J. Soc. Motion Picture Television Engrs.</u> <u>59</u> , 503-11(1952)		6-5282	<u>Laboratory Invest.</u> <u>2</u> , 1-14(1953)
3455	7-438	<u>Phys. Rev.</u> <u>89</u> , 320(1953)		6-5533	<u>Arch. Biochem. and Biophys.</u> <u>42</u> , 72-82(1953)
3456	7-147	\$0.35		6-5570	<u>Anal. Chem.</u> <u>24</u> , 2000(1952)
3466	7-706	<u>J. Opt. Soc. Amer.</u> <u>43</u> , 216(1953)		6-5546	<u>Evolution</u> <u>6</u> , 333-41(1952)
3474	7-690	<u>Phys. Rev.</u> <u>90</u> , 6-10(1953)		6-5580	<u>J. Am. Chem. Soc.</u> <u>75</u> , 461-6(1953)
3484	7-1272	\$0.20		6-5578	<u>Rev. Sci. Instr.</u> <u>24</u> , 298-303(1953)
3486	7-1666	\$0.55		6-5534	<u>Stain Technol.</u> <u>28</u> , 19-26(1953)
3488(Rev.)	7-1854	\$0.25		6-5591	<u>Rev. Sci. Instr.</u> <u>24</u> , 16-19(1953)
3494	7-2049	0.20		6-5557	<u>J. Nutrition</u> <u>49</u> , 183-90(1953)
3502	7-2356	0.35		6-5558	<u>Botan. Gaz.</u> <u>114</u> , 180-9(1952)
				6-5560	<u>J. Am. Chem. Soc.</u> <u>75</u> , 832-5(1953)
				6-5535	<u>Arch. Biochem. and Biophys.</u> <u>42</u> , 25-40(1953)
				6-5694	<u>Ann. Rev. Nuclear Sci.</u> <u>2</u> , 187-220(1952)
	2-916	<u>Rev. Sci. Instr.</u> <u>20</u> , 324(1949)		6-5576	<u>Phys. Rev.</u> <u>89</u> , 870-5(1953)
77	2-1022	<u>Arch. Biochem.</u> <u>23</u> , 131-6(1949)		6-5927	<u>Cancer Research</u> <u>12</u> , 915-17(1952)
	2-1150	NNES Div. VI, Vol. 1, Pt. IV, Chap. 24		6-5985	<u>J. Econ. Entomol.</u> <u>46</u> , 988-97(1953)
132	2-1455	NNES Div. VI, Vol. 1, Pt. IV, Chap. 24		6-5980	<u>J. Biol. Chem.</u> <u>200</u> , 515-23(1953)
				6-6102	<u>J. Chem. Phys.</u> <u>21</u> , 274-8(1953)

AECU

REPORT	ABSTRACT	AVAILABILITY	REPORT	ABSTRACT	AVAILABILITY
AECU	NSA		AECU	NSA	
2228	6-6292	J. Biol. Chem. 200, 155-9(1953)	2479	7-2757	J. Chem. Phys. 21, 589-97(1953)
2223	6-6338	J. Am. Chem. Soc. 75, 552-5(1953)	2487	7-2941	J. Am. Chem. Soc. 75, 1741-2(1953)
2227	6-6339	J. Biol. Chem. 200, 605-7(1953)	2499	7-3219	Phys. Rev. 90, 460-3(1953)
2231	6-6407	Nucleonics 11, No. 1, 70(1953)	2500	7-3198	Phys. Rev. 90, 464-8(1953)
2239(add.)	7-1449	Phys. Rev. 89, 654(1953)	2501	7-2979	J. Biol. Chem. 200, 661-8(1953)
2248	6-6238	Bull. Johns Hopkins Hosp. 92, 79-97(1953)			
2249	6-6239	Cancer Research 13, 21-6(1953)			
2253	6-6527	J. Am. Chem. Soc. 74, 6152 (1952)	127	6-2587	1s.0d.
2254	6-6647	J. Applied Phys. 24, 434-8(1953)	129	6-2770	1s.0d.
2255	6-6654	J. Chem. Phys. 21, 371-2(1953)	131	6-2872	1s.3d.
2257	6-6709	Phys. Rev. 89, 672-8(1953)	132	6-3522	1s.3d.
2260	6-6692	Non-Destructive Testing 11, No. 3, 30-3 (1953)	152	7-100	2s.6d.
2261	6-6551	J. Am. Chem. Soc. 75, 739-41(1953)	154	7-520	1s.0d.
2264	6-6494	Am. J. Roentgenol. Radium Therapy Nuclear Med. 59, 272-93(1953)			
2269	6-6617	Science 117, 343-9(1953)	552	5-2221	1s.9d.
2272	6-6661	Non-Destructive Testing 11, No. 2, 28-32 (1952)	801	6-2860	7s.0d.
2278	7-5	Arch. Pathol. 55, 20-30(1953)	813	6-3771	4s.6d.
2284	7-385	Phys. Rev. 89, 854-5(1953)	861	6-5114	7s.6d.
2286	7-505	Arch. Biochem. and Biophys. 42, 257-70 (1953)	958	6-6510	12s.6d.
2290	7-527	Rev. Sci. Instr. 24, 328-9(1953)	986	7-3156	6s.6d.
2291	7-658	Phys. Rev. 89, 760-5(1953)	988	7-2008	3s.0d.
2299	7-466	Tech. Bull. Registry Med. Technol. 23, 65-72(1953)	1004	7-1407	4s.0d.
2296	7-669	Phys. Rev. 89, 824-6(1953)	1061	7-2864	Phil. Mag. (7) 44, 208-11(1953)
2302	7-659	Phys. Rev. 89, 1251-4(1953)			
2311	7-612	J. Chem. Phys. 20, 1981-2(1952)	750	7-1472	3s.0d.
2323	7-778	J. Am. Chem. Soc. 75, 1110-15(1953)	805	6-2709	3s.0d.
2332	7-1348	\$0.20			
2334	7-1364	Proc. Soc. Exptl. Biol. Med. 82, 248-52 (1953)	817	6-2654	2s.6d.
2335	7-1317	J. Histochem. and Cytochem. 1, 123-37 (1955)			
2345	7-1365	J. Am. Chem. Soc. 75, 1680-4(1953)	96	6-2367	J. Sci. Instr. 29, 336-7(1952)
2346	7-1829	NSA	144	7-3136	1s.3d.
2354	7-1779	Phys. Rev. 90, 420-8(1953)			
2355	7-1327	Refrig. Eng. 61, 55-7, 104(1953)	462	4-2712	1s.8d.
2358	7-1679	Phys. Rev. 90, 393-400(1953)	477	4-6126	2s.0d.
2363	7-1574	Proc. Soc. Exptl. Biol. Med. 82, 137-40 (1953)	478	4-4883	4s.0d.
2365	7-1780	Phys. Rev. 89, 665(1953)	480	4-3477	1s.6d.
2366	7-1623	J. Chem. Phys. 21, 381-2(1953)	784	6-1185	2s.6d.
2367	7-1830	J. Chem. Phys. 21, 372-3(1953)	1020	7-1464	3s.6d.
2369	7-1580	Nucleonics 11, No. 3, 29-31(1953)	1039	7-2028	1s.8d.
2377	7-1581	Proc. Soc. Exptl. Biol. Med. 82, 208-12 (1953)			
2384	7-1789	Phys. Rev. 89, 1302-3(1953)	16	6-2890	1s.9d.
2387	7-1577	Proc. Soc. Exptl. Biol. Med. 81, 125-8(1952)	18	7-517	1s.0d.
2390	7-1867	J. Natl. Cancer Inst. 13, 1123-38(1953)			
2392	7-2139	Phys. Rev. 89, 1156-7(1953)			
2394	7-2116	NSA; Phys. Rev. 89, 1308(1953)	76	6-1529	5s.0d.
2398	7-2270	Published in four installments as follows: Arch. Biochem. and Biophys. 31, 72-6 (1951); Biochim. et Biophys. Acta 9, 240-6(1952); Biochim. et Biophys. Acta 9, 597-600 (1952); and J. Polymer Sci. 10, 333-44(1953)	80	6-1423	1s.0d.
			88	7-212	1s.3d.
2421	7-2486	NSA			
2426	7-2245	Arch. Ind. Hyg. Occupational Med. 7, 148- 148-51(1953)	427	5-119	J. Inst. Metals 77, 553-69(1950)
2437	6-3069	Science 115, 284-5(1952)			
2440	7-2894	Phys. Rev. 89, 1165-70(1953)	470	3-1971	2s.6d.
2441	7-2875	Phys. Rev. 89, 1271-2(1953)	987	6-6670	Phil. Mag. (7) 44, 77-84(1953)
2451	7-2716	NSA			
2462	7-2878	Phys. Rev. 90, 321-2(1953)			
2464	7-2987	J. Chem. Phys. 21, 575-88(1953)			
2465	7-2988	J. Chem. Phys. 21, 597-601(1953)	■	7-666	5s.0d.

## NUCLEAR SCIENCE ABSTRACTS

REPORT	ABSTRACT	AVAILABILITY	REPORT	ABSTRACT	AVAILABILITY
AERE R/R	NSA		BNL	NSA	
922	7-667	Nucleonics 11, No. 2, 50-60 (1952); 6s.0d.	1305	7-1498	Phys. Rev. 89, 1081-9(1953)
961	7-1506	2s.0d.	1307	7-1374	J. Am. Chem. Soc. 75, 1795-7(1953)
1019	7-1473	1s.9d.	1322	7-1500	Physica 18, 1091-3(1952)
1035	7-1507	1s.3d.	1327	7-1526	Phys. Rev. 90, 430-9(1953)
			1329	7-1596	Arch. Ind. Hyg. Occupational Med. 7, 109-10(1953)
AERE T/M			1330	7-1718	\$0.20
68	7-1517	2s.0d.	1333	7-1790	Phys. Rev. 89, 880-1(1953)
AERE T/R			1337	7-1736	Phys. Rev. 89, 1148(1953)
334	4-2758	8s.0d.	1338	7-2119	NSA; Phys. Rev. 89, 1146(1953)
437	4-1523	1s.6d.	1341	7-2198	Nucleonics 11, No. 3, 18-20(1953)
443	4-1324	1s.9d.			
451	4-2045	1s.6d.	CEA		
467	4-2421	2s.6d.	149	7-1724	J. phys. radium 13, 670-1(1952)
802	6-1003	2s.6d.	CRP		
1006	7-1463	2s.6d.	527	7-2382	Can. J. Phys. 31, 267-77(1953)
1008	7-1494	2s.6d.	HW		
1062	7-2723	1s.6d.	25210	6-6121	Nucleonics 11, No. 4, 28-31(1953)
1072	7-3229	1s.6d.	25258	7-235	\$0.10
AMRL			26763	7-1831	\$0.20
74	6-3181	Science 117, 155-6(1953)	ISC		
ANL			216	6-3546	J. Phys. Chem. 57, 215-19(1953)
4808	6-4037	J. Chem. Phys. 21, 419-23(1953)	231	6-4394	J. Am. Chem. Soc. 75, 1388-92(1952)
4816	6-4132	Rev. Sci. Instr. 24, 148-51(1953)	260	6-5991	Anal. Chem. 25, 249-52(1953)
ARL-RI/R			263	6-5738	Anal. Chem. 25, 416-19(1953)
251	5-2510	J. Sci. Instr. 29, 189-92(1952)	264	6-6014	J. Org. Chem. 18, 267-75(1953)
BMI			269	7-77	Anal. Chem. 25, 407-11(1953)
758	6-5377	\$0.10	282	7-419	Revs. Modern Phys. 25, 129-30(1953)
773	7-1111	0.10	K		
BNL			751	5-3903	Anal. Chem. 25, 619-24(1953)
97	5-4647	Biol. Progress 2, 1-52(1952)	939	6-6000	J. Chem. Phys. 21, 602-8(1953)
196	7-1857	\$0.95	940	7-532	J. Chem. Phys. 21, 609-14(1953)
216	7-2118	\$0.10	980	7-782	J. Am. Chem. Soc. 75, 1211-14(1953)
1010	6-546	J. Bacteriol. 63, 661-4(1952)	KAPL		
1016	5-6999	Arch. Biochem. and Biophys. 34, 478-9 (1951)	385	5-867	J. Applied Phys. 23, 1085-8(1952)
1055	6-1373	Heating and Ventilating 49, 95(1952)	LA		
1058	6-1792	Anal. Chem. 24, 1356-7(1952)	1475	7-617	\$0.35
1117	6-2357	Electrical Const. and Maint. 51, 58-9(1952)	LADC		
1137	6-2804	Agron. J. 44, 610-14(1952)	1183	7-2637	Rev. Sci. Instr. 24, 91-6(1953)
1138	6-3203	Am. J. Physiol. 172, 93-9(1953)	M		
1146	6-3148	Arch. Biochem. and Biophys. 43, 33-8 (1953)	1980	1-906	NNES Div. VI, Vol. 1, Pt. IV, Chap. 25
1188	6-5009	Am. Naturalist 87, 29-48(1953)	4795	7-1866	Proc. Natl. Acad. Sci. U.S. 38, 706-15 (1952)
1198	6-5263	Am. Naturalist 86, 391-8(1952)	MIT		
1203	6-5427	Rev. Sci. Instr. 24, 141-8(1953)	1103	7-1434	\$0.20
1205	6-5300	J. Am. Chem. Soc. 75, 28-30(1953)	MTA		
1212	6-5355	J. Am. Chem. Soc. 75, 30-3(1953)	10	7-2544	\$0.20
1224	6-5987	J. Biol. Chem. 200, 565-9(1953)	23	7-2855	\$0.10
1227	6-5935	J. Bacteriol. 65, 305-9(1953)	NAA-SR	NSA	
1231	6-6149	Physica 18, 1034-6(1952)	178	6-3572	Rev. Sci. Instr. 24, 80-1(1953)
1233	6-6119	NSA; Rev. Sci. Instr. 23, 769(1952)	NBS		
1234	6-6120	Rev. Sci. Instr. 23, 765(1952)	1762	6-6036	Rev. Sci. Instr. 24, 326-7(1953)
1235	6-5988	J. Biol. Chem. 200, 525-8(1953)	1955	7-348	Phys. Rev. 90, 146-50(1953)
1240	6-6388	Revs. Modern Phys. 25, 114-21(1953)	2308	7-2767	\$0.20
1245	6-5983	J. Am. Chem. Soc. 75, 1827-30(1953)			
1247	6-6091	Science 117, 1-3(1953)			
1258	6-6530	J. Am. Chem. Soc. 75, 728-30(1953)			
1262	6-6707	J. Am. Chem. Soc. 75, 1256-7(1953)			
1272	7-473	Proc. Soc. Exptl. Biol. Med. 81, 836-8(1952)			
1277	7-1808	Nucleonics 11, No. 3, 49-51(1953)			
1280	7-599	Phys. Rev. 89, 826-51(1953)			
1288	7-691	Physica 18, 1110-11(1952)			
1290	7-2399	NSA			
1300	7-999	Phys. Rev. 89, 1267-70(1953)			
1304	7-1181	\$0.25			

REPORT	ABSTRACT	AVAILABILITY	REPORT	ABSTRACT	AVAILABILITY
NM	NSA		UCLA	NSA	
006-012.04.54	7-493	<u>Am. J. Physiol.</u> <u>170</u> , 418-25 (1952)	181	6-1617	<u>J. Am. Pharm. Assoc., Sci. Ed.</u> <u>41</u> , 614-17 (1952)
NP			200	6-3890	<u>J. Bacteriol.</u> <u>65</u> , 151-8(1953)
3583	6-2104	<u>Phys. Rev.</u> <u>90</u> , 115-19(1953)	203	6-4882	<u>Cancer Research</u> <u>12</u> , 818-22(1952)
3596	6-2117	<u>Acta Cryst.</u> <u>5</u> , 811-17(1952)	205	6-4344	<u>Cancer Research</u> <u>12</u> , 823-8(1952)
3830	6-4015	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1560-2(1953)	207	6-5277	<u>Science</u> <u>117</u> , 139-40(1953)
4000	6-5568	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1830-2(1953)	209	6-5418	<u>Rev. Sci. Instr.</u> <u>24</u> , 269-71(1953)
4043	6-6554	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1232-36(1953)	210	6-5419	<u>Electronics</u> <u>26</u> , 124-5(1953)
4188	6-2480	<u>Phys. Rev.</u> <u>85</u> , 532-9(1952)	211	6-5509	<u>J. Opt. Soc. Amer.</u> <u>43</u> , 42-3(1953)
4202	7-1286	<u>J. Chem. Phys.</u> <u>20</u> , 1979(1953)	213	6-5253	<u>Am. J. Physiol.</u> <u>172</u> , 195-202(1953)
4215	7-1610	<u>J. Phys. Chem.</u> <u>57</u> , 385-90(1953)	214	6-5254	<u>Am. J. Physiol.</u> <u>172</u> , 203-10(1953)
4223	7-812	<u>Vide, Le</u> <u>7</u> , 1262-6(1952) (In French)	216	6-5552	<u>Ann. Allergy</u> <u>11</u> , 1-11(1953)
4267	7-1652	<u>J. Am. Chem. Soc.</u> <u>75</u> , 880-3(1953)	217	6-5540	<u>Proc. Soc. Exptl. Biol. Med.</u> <u>81</u> , 298-300 (1952)
4352	6-8095	<u>J. Applied Phys.</u> <u>23</u> , 1028-32(1952)	220	6-5887	<u>Rev. Sci. Instr.</u> <u>24</u> , 73-4(1953)
NYO			222	6-5971	<u>Arch. Biochem. and Biophys.</u> <u>43</u> , 118-26 (1953)
729	6-1631	<u>J. Am. Chem. Soc.</u> <u>75</u> , 451-5(1953)	224	7-40	<u>Proc. Soc. Exptl. Biol. Med.</u> <u>81</u> , 665-7 (1952)
769	6-6363	<u>J. Applied Phys.</u> <u>24</u> , 52(1953)	231	7-101	<u>Am. Ind. Hyg. Assoc. Quart.</u> <u>14</u> , 26-30 (1953)
793	6-1400	<u>Anal. Chem.</u> <u>25</u> , 482-6(1953)	237	7-714	\$0.20
1642	6-3743	<u>Radiology</u> <u>59</u> , 849-57(1952)	244	7-2719	<u>J. Am. Pharm. Assoc. Sci. Ed.</u> <u>41</u> , 614-17 (1953)
3001	6-2740	<u>Phys. Rev.</u> <u>85</u> , 489-90(1952)	UCRL		
3006	6-1801	<u>Rev. Sci. Instr.</u> <u>24</u> , 193-5(1953)	1198	5-3647	\$0.25
3067	6-5315	<u>Anal. Chem.</u> <u>25</u> , 127-30(1953)	1390	7-496	<u>J. Aviation Med.</u> <u>23</u> , 345-72(1952)
3201	7-2897	<u>Phys. Rev.</u> <u>90</u> , 160-1(1953)	1505	6-93	<u>J. Am. Chem. Soc.</u> <u>74</u> , 3431(1952)
3225	6-6134	<u>Phys. Rev.</u> <u>89</u> , 766-74(1953)	1549	6-38	<u>Am. J. Physiol.</u> <u>172</u> , 579-87(1953)
3262	7-2181	<u>Phys. Rev.</u> <u>89</u> , 664(1953)	1621(rev)	6-5464	<u>Phys. Rev.</u> <u>87</u> , 425-33(1952)
3367	6-1633	<u>J. Am. Chem. Soc.</u> <u>75</u> , 455-7(1953)	1687	6-3261	<u>J. Am. Chem. Soc.</u> <u>75</u> , 474-9(1953)
3368	6-1634	<u>J. Am. Chem. Soc.</u> <u>75</u> , 457-60(1953)	1720	6-3260	<u>Ann. Rev. Phys. Chem.</u> <u>3</u> , 215-28(1952)
3581	6-4411	<u>J. Electrochem. Soc.</u> <u>100</u> , 131-5(1953)	1795	6-4083	<u>Elec. Eng.</u> <u>72</u> , 212-18(1953)
3631	7-2761	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1735-6(1953)	1863	7-1831	\$0.25
3661	6-6440	<u>Phys. Rev.</u> <u>80</u> , 83-6(1953)	1875	6-5864	<u>J. Am. Chem. Soc.</u> <u>74</u> , 4216(1952)
3814	7-2871	<u>J. Applied Phys.</u> <u>24</u> , 365(1953)	1876	6-6435	<u>Phys. Rev.</u> <u>90</u> , 183-5(1953)
3871	7-711	<u>J. Am. Chem. Soc.</u> <u>75</u> , 466-70(1953)	1876	6-6435	<u>Phys. Rev.</u> <u>90</u> , 224-32(1953)
3901(p.15-36)	7-390	<u>Phys. Rev.</u> <u>89</u> , 679-83(1953)	1899	6-5856	<u>Phys. Rev.</u> <u>89</u> , 603-5(1953)
4026	6-6524	<u>New Engl. J. Med.</u> <u>247</u> , 877-80 (1952)	1913(rev.)	7-350	<u>J. Am. Chem. Soc.</u> <u>75</u> , 796-7(1953)
4435	6-6576	\$0.80	1918	6-6330	<u>Phys. Rev.</u> <u>89</u> , 1019-22(1953)
4436	6-6542	0.45	1937	6-6696	<u>Phys. Rev.</u> <u>89</u> , 469-72(1953)
4503	7-2300	<u>Nucleonics</u> <u>11</u> , No. 4, 34-9(1953)	1939	6-6671	\$0.35
4506	7-1966	\$0.20	1950	7-510	<u>Nucleonics</u> <u>11</u> , No. 3, 56, 58(1953)
ORNL			1955	7-41	<u>J. Am. Chem. Soc.</u> <u>75</u> , 1962-7(1953)
1044	6-192	<u>Instruments</u> <u>25</u> , 1096-1101(1952)	1956	7-58	<u>Phys. Rev.</u> <u>89</u> , 790-2(1953)
1342	7-1695	\$0.20	1991	7-681	<u>Phys. Rev.</u> <u>89</u> , 758-9(1953)
1347	6-6689	\$0.20	1996	7-978	\$0.55
1405	7-626	\$0.20	2004	7-1095	\$0.20
1414	7-2425	0.25	2005	7-937	<u>Phys. Rev.</u> <u>89</u> , 878-9(1953)
1461	7-2307	\$0.20	2008	7-1402	\$0.25
1470	7-2030	0.20	2013	7-1486	\$0.55
1499	7-2880	\$0.10	2019	7-1834	<u>Phys. Rev.</u> <u>90</u> , 287-70(1953)
ORO			2031	7-1816	<u>Phys. Rev.</u> <u>89</u> , 879-80(1953)
81	7-113	<u>J. Chem. Phys.</u> <u>21</u> , 383-93(1953)	2037	7-1519	\$0.20
RCC/R			2041	7-2533	\$0.20
26	7-245	4s.0d.	2060	7-1835	\$0.55
			2062	7-1763	0.35
			2075	7-2613	0.10
			2079	7-1839	\$0.10
			2108	7-2828	0.20
REU			UR		
87	7-1443	\$0.25	78	3-1623	<u>Science</u> <u>111</u> , 117-8(1950)
120	7-2308	\$0.45	132	5-1249	<u>J. Am. Chem. Soc.</u> <u>73</u> , 1212-15(1951)
SO			142(p.29-40)	5-2369	<u>Am. J. Physiol.</u> <u>163</u> , 715(1950); <u>J. Pharmacol. Exptl. Therap.</u> <u>101</u> , 14(1951)
3501	7-539	\$0.55	176	5-4308	<u>J. Biol. Chem.</u> <u>183</u> , 243-51(1953)
UCLA			185	6-2580	<u>Biochim et Biophys. Acta</u> <u>8</u> , 369-74(1952)
128	5-3849	<u>Am. J. Roentgenol. Radium Therapy</u> <u>Nuclear Med.</u> <u>68</u> , 950-3(1952)	187	5-6953	<u>Proc. Soc. Exptl. Biol. Med.</u> <u>78</u> , 687-9 (1951)
134	5-4105	<u>Rev. Sci. Instr.</u> <u>24</u> , 78-9(1953)	213(p.56)	6-5541	<u>Federation Proc.</u> <u>11</u> , 133(1952)
			213(p.57)	6-5541	<u>Federation Proc.</u> <u>11</u> , 183(1952)

REPORT UR	ABSTRACT NSA	AVAILABILITY	REPORT UR	ABSTRACT NSA	AVAILABILITY
213(p.58)	6-5541	Federation Proc. <u>11</u> , 278(1952)	213(p.67)	6-5541	Federation Proc. <u>11</u> , 416(1952)
213(p.59)	6-5541	Federation Proc. <u>11</u> , 280(1952)	213(p.68)	6-5541	Federation Proc. <u>11</u> , 278(1952)
213(p.60)	6-5541	Federation Proc. <u>11</u> , 260(1952)	213(p.69)	6-5541	Federation Proc. <u>11</u> , 162(1952)
213(p.61)	6-5541	Federation Proc. <u>11</u> , 182(1952)	215	6-5543	J. Biol. Chem. <u>200</u> , 759-63(1953)
213(p.62)	6-5541	Federation Proc. <u>11</u> , 299(1952)	233	7-2463	Am. J. Anat. <u>92</u> , 153-87(1953)
213(p.63)	6-5541	Federation Proc. <u>11</u> , 4(1952)	USNRDL		
213(p.64)	6-5541	Federation Proc. <u>11</u> , 114(1952)	340	6-3490	J. Aviation Med. <u>24</u> , 57-62(1953)
213(p.65)	6-5541	Federation Proc. <u>11</u> , 423(1952)			
213(p.66)	6-5541	Federation Proc. <u>11</u> , 359(1952)			

# NEW NUCLEAR DATA

Summary of New Nuclear Data on Half Lives, Radiations, Relative Isotopic Abundances, Nuclear Moments, Neutron Cross Sections, Reaction Energies, and Masses.

Prepared by National Bureau of Standards Nuclear Data Group with assistance of Readers.

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The material cumulated here is that which has appeared in NSA Vol. I, Nos. 7 through 12A.

## ABBREVIATIONS

a	absorption measurement	E	average energy
$a\beta\gamma$	absorption of $\beta$ 's in coincidence with $\gamma$ 's	$E_0$	resonance energy
$ace^-$	absorption of conversion electrons	$E_\beta, E_\gamma, \dots$	energy of $\beta$ ray, energy of $\gamma$ ray, ...
a coin	measurement by placing absorbers between counters in coincidence	$E_{dis}$	disintegration energy
$\alpha$	total $\gamma$ -ray conversion coefficient, $N_e/N_\gamma$	EA	electrostatic analyzer
$\alpha_K, \alpha_L, \dots$	$\gamma$ -ray conversion coefficient for electrons ejected from the K,L,... shell	$E1, E2, \dots$	electric dipole, electric quadrupole
b	coefficient in angular correlation function, $1 + b \cos^2 \theta$	$\epsilon$	electron capture
B	band spectra method	$\epsilon_K, \epsilon_L$	electron capture from K, L shell
$Be\gamma\gamma$	measurement by detection of photoneutrons from Be	f	fission, in abbreviations for methods of production or detection
$\beta\gamma, \gamma\gamma$	$\beta\gamma$ or $\gamma\gamma$ coincidences	F-K	Fermi-Kurie $\beta$ energy distribution plot
$\beta\gamma(\theta)$	angular correlation of $\beta$ 's and $\gamma$ 's in coincidence	$\gamma(\theta, T)$	numbers of $\gamma$ 's as function of angle and temperature
Calc	calculated value from experimental work reported elsewhere	$\Gamma$	resonance half-width (the whole width at half-maximum)
cc	cloud chamber	g.s.	ground state
$ce^-$	conversion electrons	I	(1) spin in units of $h/2\pi$ ; (2) nuclear induction magnetic resonance method
chem	chemical separation of product following reaction	ic	ionization chamber
Cpt	Compton electrons	J	quantum state of compound nucleus in a nuclear reaction. "I" is used to denote the spin of the target nucleus, final nucleus
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript	K/L	$\alpha_K/\alpha_L$
$d, p(\theta)$	angular distribution of protons with respect to deuteron beam	$l$	angular momentum of particle absorbed into nucleus
Dyn, Dyp	measurement by detection of photoneutrons or photoprotons from deuterium	M	molecular or atomic beam resonance method
		M1, M2, ...	magnetic dipole, magnetic quadrupole ...

mb	millibarns	st	strong
Mic	microwave method	$s\pi$	$180^\circ$ spectrometer
mir	measurement by total reflection of neutron beam from mirror surface	$s\pi\sqrt{2}$	double focusing spectrometer
ms	mass spectrometer	$\sigma$	cross section in barns
$\mu$	(1) magnetic moment in units of nuclear magnetons, (2) micron, $10^{-4}$ cm	$\sigma_0$	cross section at resonance energy, $E_0$
$\mu s$	microseconds	$\sigma_a$	absorption cross section
osc	pile oscillator method	$\sigma_{el}$	elastic scattering cross section
p	(1) proton, (2) predecessor of	$\sigma_{in}$	inelastic scattering cross section
para	paramagnetic resonance method	$\sigma_s$	scattering cross section
pc	proportional counter	$\sigma_t$	total cross section
pe-	photo electrons	t	triton, $H^3$
ppl	photoplates or emulsions	$\tau$	half life in units indicated
q	electric quadrupole moment in units of barns	$\tau_{1,2}$	half life of upper, lower state
Q	reaction energy in Mev	th	thermal
s	(1) spectrometer method; (2) seconds, when used as superscript	w,vw	weak, very weak
S	atomic-spectra measurement	(0.123)	$\beta$ and $\gamma$ energy values enclosed in parentheses are given for identification purposes
scin	scintillation counter	%	% of disintegrations
sl	lens spectrometer	†	relative numbers. When used in connection with $\gamma$ rays, relative numbers of photons, not photons plus conversion electrons, are meant
sl;ce-	conversion electrons measured in lens spectrometer	+,-	even, odd parity

Standard journal abbreviations are used.

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

### MAGNETIC MOMENT STANDARDS

In order to have a consistent basis for recording data on magnetic moments, results have been based on the following values and are without diamagnetic corrections.

$$\mu(H^1) = 2.7934 \text{ nuclear magnetons}$$

This value has been adopted arbitrarily because it is the one used as a base in the Table of H. L. Poss, The Properties of Atomic Nuclei, I. Spins, Magnetic Moments and Electric Quadrupole Moments. (Revised, BNL-26 (T-10), (unclassified).) The values reported in the New Nuclear Data summaries are thus directly comparable with those listed in the survey of Poss.

$$\nu(Na^{23})/\nu(H^1) = 0.26450 \quad E. Bléuler, M. Gabriel, Helv. Phys. Acta 20, 67(1947).$$

$$\nu(D)/\nu(H^1) = 0.153506 \quad F. Bloch, E. C. Levinthal, M. E. Pachard, Phys. Rev. 72, 1125(1947).$$

$$\nu(B^{11})/\nu(H^1) = 0.320827 \quad D. A. Anderson, Phys. Rev. 76, 434(1949).$$

## NEW NUCLEAR DATA

$\frac{He}{2}^4$

$H^3(p,\gamma)$   $E_p = 1$  to  $5.2$

No resonance for production of  $\sim 20$ -Mev  $\gamma$ 's  
 $\gamma$  yield curve flattens at  $\sim E_p = 3.5$

H.B.Willard, J.K.Bair, J.D.Kington, ORNL-1415,  
 3(1952).

$He^3(d,p)$   $E_d = 10.2$  ppl

No level below 20.9 Mev ( $d\sigma/d\Omega$  for excited state  $< 0.2$  mb/sterad. at  $90^\circ$  lab.)

J.C.Allred, Phys. Rev. 84, 695(1951).

$He^4(p,p')$   $E_p = 32$  pc

No level below 23.3 Mev ( $d\sigma/d\Omega$  for low energy p group  $< 0.1$  mb/sterad. at  $45^\circ$  c.m.)

J.Benveniste, B.Cork, Phys. Rev. 89, 422(1953).

$\frac{He}{2}^5$

Levels  $H^3(He^3,p)$   $E_{He^3} = 0.30$  scin  
 g.s. group observed at  $E_p = 9.05$   
 No other p group found

W.M.Good, W.E.Kunz, C.D.Moak, ORNL-1415(1952).

$\frac{Li}{3}^6$

No reaction  $Li^6(\gamma,d)He^4$   
 $\sigma < \sim 6 \times 10^{-6}$  for  $E_\gamma = 2.76, \sim 7, 17.8$   
 Isotopic spin forbidden\*

\*A.Bamba, V.Wataghin, Nuovo Cim. 10, 174(1953).  
 E.W.Titterton, T.A.Brinkley, Proc. Phys. Soc. 65A, 1052(1952).

$\frac{Li}{3}^7$

Level  $Li^6(d,p)$   $Be^9(d,\alpha)$  s  
 0.477

E.R.Collins, C.D.McKenzie, C.A.Ramm, Proc. Roy. Soc. 216A, 242(1953).

Levels  $Be^9(d,\alpha)$  s  
 Level  $E_d = 0.47$   $E_d = 1.0$   
 g.s.  $100^+$   $100^+$   
 (0.48)  $100^+$   $70^+$   
 4.62  $20^+$   $100^+$

$H^3$  continuum observed from 4.62 level

+ Relative yields at  $90^\circ$

R.W.Gellinas, S.S.Hanna, Phys. Rev. 89, 483(1953).

Levels  $B^{10}(n,\alpha)$   $E_n = \text{th}$  pc  
 5.8† g.s.  
 94.2† (0.48)

† Relative cross sections

U.H.Hauser, Z. Naturf. 7a, 781(1952).

Level  $Li^6(d,p\gamma)$   $E_d = 0.41$   
 $DY(\theta)$  (0.478)  $I = 1/2$

A.J.Salmon, E.K.Inall, Proc. Phys. Soc. 66A, 297(1953).

$\frac{3}{3} Li^7$

Level  $Li^6(n,t)He^4$   $E_n = 0.27$  ppl  
 $n,t(\theta)$  (7.4)  $J = 5/2$

W.O.Solano, J.H.Roberts, Phys. Rev. 89, 892A (1953).

Levels  $Li^7(\gamma,\alpha)H^3$   $E_\gamma = 6.13$  ppl  
 $\gamma,\alpha(\theta)$  suggests  $3/2^+, 1/2^-$  interference  
 $\sigma = 2.7 \times 10^{-5}$

H.Nabholz, P.Stoll, H.Wäffler, Helv. Phys. Acta 25, 701(1952).

Resonances  $Li^7(\gamma,t)He^4$   $E_\gamma \leq 24$  ppl  
 9.3 21.5?  
 16.7? 23.5?

No structure resolved for  $Li^7(\gamma,p)He^4$

E.W.Titterton, T.A.Brinkley, Proc. Phys. Soc. 66A, 194(1953).

$\frac{3}{5} Li^8$

$\tau$  0.87 s  $Li(0.8\text{-Mev } d)$

P.Bretonneau, Compt. rend. 236, 913(1953).

I 3?  $Li^7(d,p)$  scin  
 (12.5?) (1.5a)  $(\theta)$  consistent with  
 I = 3, 2, 0 and not I = 0, 2, 0

C.M.Clark, S.S.Hanna, Phys. Rev. 89, 877(1953).

$\frac{3}{6} Li^9$

$\beta^-$  and 2  $\alpha$ 's found in  $\mu$  meson star

$E_{\beta^-} \sim 8$ ,  $E_\alpha(\text{total}) = 4.4$  indicate decay of  
 $Li^9$  via 6.8 level of  $Be^9$

W.F.Fry, Phys. Rev. 89, 325(1953).

$\frac{4}{3} Be^7$

No reaction observed for  $He(\alpha,n)$   
 $\sigma < 7 \times 10^{-4}$  for  $E_\alpha = 39$  (threshold = 38)  
 Consistent with odd parity for g.s.

D.Walker, W.T.Link, W.I.B.Smith, Proc. Phys. Soc. 65A, 861(1952).

$\frac{4}{4} Be^8$

Level  $Be^9(d,t)$  ppl  
 g.s.

$d,t(\theta)$  for  $E_d = 0.295, 0.40, 0.45, 0.52, 0.62$

D.deJong, P.W.Endt, L.J.G.Simons, Physica 18, 676(1952).

Levels  $B^{10}(d,\alpha)$   $E_d = 0.59, 0.78, 1.07$   
 g.s.

2.9  $I = 2^*$

\*From fit of theoretical curve to  $\alpha$  energy spectrum

Only two  $\alpha$  peaks at  $E_\alpha \sim 12, \sim 9$

P.B.Treacy, Phil. Mag. 44, 325(1953).

$\text{Be}^8$ 

Levels	$\text{Be}^9(\text{d},\text{t})$	$E_d = 1.0$	s
3.5 <sup>+</sup>	g.s.		
15 <sup>+</sup>	(2.9)		

†Relative yields at 90°

R.W.Gellinas, S.S.Hanna, Phys. Rev. 89, 483(1953).

Levels	$\text{Li}^6(\text{He}^3,\text{p})$	$E_{\text{He}^3} = 0.72$	scin
	g.s.		

Only two peaks at  $E_p = 14.6, 12.0$ 

W.M.Good, W.E.Kunz, C.D.Moak, ORNL-1415(1952).

Levels	$\text{Li}^7(\text{d},\text{n})$	$E_d = 0.68$	ppl
2.2 ?	4.1		
2.9	5.0		

\*Seen for small angles only

 $d,n(\theta)$  shows both stripping and compound nucleus formation

B.Trumpy, T.Grotdal, A.Graue, Nature 170, 1118 (1952).

Level	$\text{Li}^7(\text{d},\beta^-) 2\alpha$	scin
(~3)	I = 2	
(12.5β) (1.5α) (θ)	consistent with I = 3, 2, 0	

C.M.Clark, S.S.Hanna, Phys. Rev. 89, 877(1953).

Resonance	$\text{Li}^7(p,\gamma)$	$\Gamma = 12.2 \text{ kev}$	EA
	0.4415		

S.E.Hunt, Proc. Phys. Soc. 65A, 982(1952).

 $\text{Be}^{10}$ 

Capture γ's	$\text{Be}^9(n,\gamma)$	pair s
25 †	3.41	
75 †	6.81	

No 6.3γ observed

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 49(1953).

Level	$\text{Be}(d,p)$	ppl
	g.s.	
$d,p(\theta)$ for $E_d = 0.295, 0.40, 0.45, 0.52, 0.62$		

D.deJong, P.M.Endt, L.J.G.Simons, Physica 18, 676(1952).

 $\text{B}^{10}$ 

μ	1.80114*	I
	1.80082**	

${}^*\nu(B^{10})/\nu(D) = 0.700065 \pm 0.000007$

${}^{**}\nu(B^{10})/\nu(Rb^{89}) = 1.11282 \pm 0.000005$



Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

Level	$\text{B}(n,\gamma)$	$E_n = 2.5$	scin
γ	0.717		

R.B.Day, Phys. Rev. 89, 908A(1953).

 $\text{B}^{11}$ 

$\text{Be}^9(d,t)\text{Be}^8$	$E_d = 1.3$	ppl
$d,t(\theta)$ shows forward peaking suggesting pick-up		

P.Cuér, J.J.Jung, Phys. Rev. 89, 1151(1953).

 $\text{B}^{11}$ 

$\sigma$ 's equal for $E_d < 0.40$	$\text{Be}^9(d,t)\text{Be}^8$	$\text{Be}^9(d,p)\text{Be}^{10}$
D.deJong, P.M.Endt, L.J.G.Simons, Physica 18, 676(1952).		ppl

 $\text{B}^{12}$ 

$\tau$	0.022 <sup>s</sup>	B(0.6-Mev d)
P.Bretonneau, Compt. rend. 236, 913(1953).		

 $\text{C}^{11}$ 

$\tau$	20.25 <sup>m</sup>	$\text{C}^{12}(30-\text{Mev p}) \text{ scin}$
W.M.Martin, S.W.Breckon, Can. J. Phys. 30, 643 (1952).		

 $\text{C}^{12}$ 

Levels	$\text{B}^{11}(d,n)$	$E_d = 8.1$	ppl
g.s.	$l_p = 1$		
(4.43)	$l_p = 1$		

W.M.Gibson, Phil. Mag. 44, 297(1953).

Level	$\text{N}^{15}(p,\alpha\gamma)$	$E_p = 0.429,$	s
$D,\gamma(\theta); D,\alpha(\theta)$		0.890, 1.210	

(4.43) I = 2 + A.A.Kraus, Jr., A.P.French, W.A.Fowler, C.C.Lauritsen, Phys. Rev. 89, 299(1953).

Level	$\text{C}^{12}(p,py)$	$E_p = 7.1$	scin
$D,\gamma(\theta)$	(4.43)	I = 2	

H.E.Gove, N.S.Wall, Can. J. Phys. 31, 189(1953).

Level	$\text{C}^{12}(n,ny)$	$E_n = 5.5$	
γ	4.45		scin

R.B.Day, Phys. Rev. 89, 908A(1953).

Levels	$\text{B}^{11}(p,\gamma)$	$E_p = 0.7$	
(~16.1)			

 $\rho,\gamma(\theta)$  for 11.8γ indicates interference between levels of opposite parity

G.L.Jenkins, L.W.Cochran, H.H.Given, J.L.Ryan, T.M.Hahn, B.D.Kern, BAPS 28, 2, DA7(1953).

Levels	$\text{C}^{12}(\gamma,3\alpha)$	$E_\gamma \leq 70$	ppl
18	others?	310 stars	

W.K.Dawson, C.B.Bigham, Can. J. Phys. 31, 167 (1953).

$\text{C}^{12}(\gamma,\alpha)\text{Be}^8$	$E_\gamma = 17.6$	ppl
$\sigma(\text{Be}^8 \text{ g.s.})/\sigma(\text{Be}^8 \sim 3-\text{Mev level}) = 0.025$ (cf $\text{O}^{16}$ )		

H.Nabholz, P.Stoll, H.Wäffler, Helv. Phys. Acta 25, 701(1952).

 $\text{C}^{13}$ 

Capture γ's	$\text{C}^{12}(n,\gamma)$	pair s
30 †	3.68	

No 3.9γ observed ( $< 6 \dagger$ )

† Photons per 100 n captures

G.K.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 93(1953).

<b>C<sup>14</sup></b> 6 8	F-K plot concave toward energy axis below 50 kev although S <sup>35</sup> and Pm <sup>147</sup> plots linear to 10 kev  J.P. Mize, D.J. Zaffarano, BAPS 28, 2 DA6 (1953).	<b>F<sup>19</sup></b> 9 10	$\gamma$ 's	P <sup>19</sup> (n,ny)	$E_n = 2.5$	scin
<b>N<sup>14</sup></b> 7 7	$\mu$ 0.40370 I $\nu(N^{14})/\nu(Rb^{85}) = 0.74837 \pm 0.00004$ HNO <sub>3</sub> , RbCl  Y.Ting, D.Williams, Phys. Rev. 89, 595 (1953).	<b>F<sup>20</sup></b> 9 11	Levels d,p( $\theta$ )	F <sup>19</sup> (d,p) g.s. $l_n = 0$ and 2 (0.65) $l_n = 2$ (~2.05) $l_n = 2$ (~3.49) $l_n = 0$	$E_d = 3.6$	ic
<b>O<sup>15</sup></b> 8 7	Levels N <sup>14</sup> (d,n) E <sub>d</sub> = 7.7 ppl g.s. $l_p = 1$ 5.3 $l_p = 2?$ 6.2 $l_p = 1?$ 6.8 $l_p = 0$ 7.5 $l_p = 1?$ 8.4 $l_p = 1?$ 9.1 $l_p = 1?$			D.A.Bromley, J.A.Brunner, H.W.Fulbright, Phys. Rev. 89, 396 (1953).		
	W.H.Evans, T.S.Green, R.Middleton, Proc. Phys. Soc. 66A, 108 (1953).	<b>Me<sup>20</sup></b> 10 10	Resonances	F <sup>19</sup> (p, $\alpha\gamma$ ) 0.3404 $\Gamma = 2.9$ kev 0.4831 $\Gamma = 2.2$ kev		EA
				S.E.Munt, Proc. Phys. Soc. 65A, 982 (1952).		
<b>O<sup>16</sup></b> 8 8	Levels N <sup>15</sup> (p, $\alpha\gamma$ )C <sup>12</sup> scin D, $\gamma(\theta)$ (12.51) J = 2- (12.95) J = 2- (13.24) J = 3- or 4+  4.43 $\gamma$ studied for E <sub>p</sub> = 0.43, 0.90, 1.2  C.A.Barnes, D.B.James, G.C.Nelson, Can. J. Phys. 30, 717 (1952).	<b>Level</b>	Na <sup>23</sup> (D, $\alpha$ )	$E_p = 1.46, 2.92$	EA	
				1.634		
				D.J.Donahue, K.W.Jones, M.T.McEllistrem, H.T. Richards, Phys. Rev. 89, 824 (1953).		
		<b>Level</b>	F <sup>19</sup> (p, $\gamma$ )	$E_p = 0.70$	scin	
		(>7.5 $\gamma$ ) ( $\gamma$ )	1.66			
				G.A.Jones, D.W.Wilkinson, Proc. Phys. Soc. 65A, 1055 (1952).		
		<b>Levels</b>	O <sup>16</sup> ( $\alpha,\alpha$ )			
		$\alpha,\alpha(\theta)$	6.738 J = 0 7.182 J = 3 7.218 J = 0 7.450 J = 2 7.854 J = 2			
				J.R.Cameron, R.H.Davis, A.S.Divatia, F.J.Epling, R.W.Hill, Phys. Rev. 89, 909A (1953).		
	<b>Levels</b> O <sup>16</sup> (n,n) E <sub>n</sub> = 14.1 cc (~6 Mev excitation) / (~12 Mev excitation) ~ 5  J.P.Conner, Phys. Rev. 89, 712 (1953).	<b>Na</b>	Neutron resonance (ev) E <sub>n</sub> = 1 ev to 10 kev ~3500 $\sigma \Gamma^2 = 58 \times 10^6$			
				E.R.Hodgson, J.F.Gallagher, E.M.Bowey, Proc. Phys. Soc. 65A, 992 (1953).		
		<b>Na<sup>22</sup></b> 11 11	(0.55 $\beta^+$ ) / (1.82 $\beta^+$ ) ~ 1800			S
			B.T.Wright, Phys. Rev. 89, 902A (1953).			
		<b>Na<sup>23</sup></b> 11 12	Level Na <sup>23</sup> (p,p) $E_p = 1.46$	EA		
			0.439			
			D.J.Donahue, K.W.Jones, M.T.McEllistrem, H.T. Richards, Phys. Rev. 89, 824 (1953).			
<b>O<sup>17</sup></b> 8 9	Level N <sup>14</sup> ( $\alpha,p$ ) E <sub>a</sub> = 4.80 ppl 0.86	<b>Na<sup>24</sup></b> 11 13	I $\mu$ 4 asymmetrical for elastic n's, symmetrical for inelastic	+ 1.690		M
	E.Hjalmar, H.Siätis, Phys. Rev. 89, 1151 (1953).					
	O <sup>16</sup> (n,n) E <sub>n</sub> = 14.1 cc n,n( $\theta$ ) asymmetrical for elastic n's, symmetrical for inelastic			$\Delta F = \pm 1, \Delta m = \pm 1$ transitions studied $\Delta\nu(Na^{24}) / \Delta\nu(Na^{23}) = 1139.35 / 1771.61$		
	J.P.Conner, Phys. Rev. 89, 712 (1953).			E.H.Bellamy, K.F.Smith, Phil. Mag. 44, 33 (1953).		

$Mg^{24}$ 

Level $\gamma$	$Mg(n,n\gamma)$ 1.365	$E_n = 2.5$ scin
R.B.Day, Phys. Rev. 89, 908A(1953).		
Level	$Mg(p,p)$ $1.371 \pm 0.002$	$E_p = 2.41$ EA

D.J. Donahue, K.W. Jones, M.T. McEllistrem, H.T. Richards, Phys. Rev. 89, 824(1953).

Capture $\gamma$ 's	$Na^{23}(p,\gamma)$	$E = 0.305$ scin
28+	1.38	$\leq 5 + 5.8$
$\leq 4 +$	2.41 ?	$\leq 2 + 6.2$
24 + {	2.88 ? $\sim 3.6$	20 + { 6.8 7.5
	4.2	11 + 10.3

H.Casson, Phys. Rev. 87, 215A(1952); 89, 809 (1953).

 $Mg^{25}$ 

Levels	$Mg^{24}(d,p)$	$E_d = 8$	pc
$d, p(\theta) 15.4 +$	g.s. (0.58) (0.98) (1.61)	$l_n = 2$ $l_n = 0$ $l_n = 0$ isotropic	
6.2 +	(1.96) (~2.7)	$l_n = 2$ $l_n = 0$	
8.7 +	(3.40)	$l_n = 1$	
	4.62		
	5.05		
	5.49		
	6.40		

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A, 258 (1953).

 $Mg^{26}$ 

Levels	$Mg^{25}(d,p)$	$E_d = 8$	pc
$d, p(\theta) \sim 2 +$	g.s. (1.83)	$l_n = 0$ (60%), 2 (40%)	
13 +	(2.97)	$l_n = 0$	
5.7 +	(3.97)	$l_n = 0$	
6.1 +	(4.35)	$l_n = 0$	
5.6 +	(6.15)	$l_n = 0$	
3.3 +			
	7.29		
	8.28		

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A, 258 (1953).

 $Mg^{27}$ 

$\tau$	$9.39^m \pm 0.03$	Mg(pile n)
Counted with $\beta$ electroscope		

K.J.Bobin, E.E.Lockett, quoted by E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3, 14(1953).

$\tau$	$9.45^m \pm 0.03$	Mg(pile n)
Counted with $\beta$ electroscope		

B.W.Sargent, L.Yaffa, A.P.Gray, Can. J. Phys. 31, 235(1953).

Levels	$Mg^{26}(d,p)$	$E_d = 8$	pc
$d, p(\theta) 2.8 +$	g.s. (0.99)	$l_n = 0$ $l_n = 2$	
4.8 +	(3.50)	$l_n = 0$	

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A, 259(1953).

$Mg^{28}$	$\tau$	$21.3^h$	p 2.3 <sup>m</sup> Al Mg(39-Mev a)
		Si(<100-Mev $\gamma$ )	chem

R.K.Sheline, N.R.Johnson, Phys. Rev. 89, 520(1953).

$\tau$	$21^h$	p 2.3 <sup>m</sup> Al Cl(340-Mev p), chem
$\beta^-$	$\sim 0.4$	
$\gamma$	$< 0.1$	

M.Lindner, Phys. Rev. 89, 1150(1953).

$Al^{25}$	Levels	$Mg^{24}(d,n)$	$E_d = 3.97$	ppl
$d, n(\theta)$	g.s.	$l_p = 2$		
	0.45	$l_p = 0$		
	0.95	$l_p = 1$ or 2		
	1.81			
	1.94 ?			
	2.51			
	2.70			
	2.92 ?			
	3.09			

E.Goldberg, Phys. Rev. 88, 159A(1952); 89, 760 (1953).

Capture $\gamma$ 's	$Mg(p,\gamma)$	$E_p = 0.27$	scin
$\sim 8 +$	0.48		
6 +	1.95		
2 +	2.35		

No higher energy  $\gamma$ 's observed

H.Casson, Phys. Rev. 87, 215A(1952); 89, 809 (1953).

$Al^{27}$	Level	$Al^{27}(p,p)$	$E_p = 2.31$	EA
		0.843		

D.J.Donahue, K.W.Jones, M.T.McEllistrem, H.T. Richards, Phys. Rev. 89, 824(1953).

Levels	$Al^{27}(n,n\gamma)$	$E_n = 2.5$	scin
$\gamma$	0.843		
	1.018		
	2.20		

R.B.Day, Phys. Rev. 89, 908A(1953).

$Si^{28}$	Capture $\gamma$ 's	$Al^{27}(p,\gamma)$	$E_p = 0.325, 0.404$
$14 + 14$	$12 +$	1.81	$\sim 14 + \{ 7.1$
	$12 +$	2.82	{ 7.5
	5 + {	4.65	
		5.0	

H.Casson, Phys. Rev. 87, 215A(1952); 89, 809 (1953).

$Si^{29}$	Levels	$Si^{28}(d,p) Si^{29}$	$E_d = 8$	pc
$d, p(\theta)$	Level	$l_n -$		
	g.s.	0		
	(1.28)	2		
	(2.03)	2		
	(3.07)	2		
	(3.62)	3		
	(4.93)	1		
	(6.38)	1		

J.R.Holt, T.N.Marsham, Phys. Rev. 89, 665(1953).

**Si<sup>32</sup>**  
14 18       $\tau < 2.6^h$  or  $> 100^y$       Cl(340-Mev p),  
2.6<sup>h</sup> Si<sup>31</sup> observed in high abundance      chem  
M.Lindner, Phys. Rev. 89, 1150(1953).

**P<sup>30</sup>**  
15 15       $\tau$       2.52<sup>m</sup>      Al( $\alpha$ ,n)  
K.Baskova, A.Kudriavtseva, Zhur. Eksptl' i Teoret. Fiz. 23, 483(1952).

**P<sup>32</sup>**  
15 17       $\tau$       14.50<sup>d</sup>  $\pm 0.04$       P(pile n)  
Counted for 5 half-lives with  $\beta$  electro-  
scope  
No estimate of P<sup>33</sup> contamination given  
E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3,  
14(1953).

$E_\beta = 0.694 \pm 0.025$       ic and  $4\pi$  counter  
J.M.Brabant, L.W.Cochran, R.S.Caswell, BAPS 28,  
2, DA 5(1953).

Continuous  $\gamma$  spectrum      scin  
 $\gamma(E_\gamma > 0.09)/\beta^- = 0.0023$   
P.Bulgiano, L.Madansky, F.Rasetti, Phys. Rev.  
89, 679(1953).

**S<sup>32</sup>**  
16 16      Level      S(n,ny)       $E_n = 2.5$       scin  
 $\gamma$       2.23  
R.B.Day, Phys. Rev. 89, 908A(1953).

**S<sup>33</sup>**  
16 17      Levels      S<sup>32</sup>(d,p)S<sup>33</sup>       $E_d = 8$       pc  
d,p( $\theta$ )      Level       $l_{n-}$   
g.s.      2  
(0.85)      0  
(2.80)      3  
(3.26)      1  
(4.21)      1  
(4.89)      1  
(5.72)      1  
J.R.Holt, T.N.Marsham, Phys. Rev. 89, 665(1953).

**Cl<sup>33</sup>**  
17 16      Levels      S(d,n)       $E_d = 8$       ppl  
d,n( $\theta$ )      g.s.       $l_p = 2$   
0.76       $l_p = 0$   
 $\sim 1.89$   
2.84       $l_p = 1$   
4.22       $l_p = 1$   
R.Middleton, F.A.El-Bedewi, C.T.Tai, Proc. Phys.  
Soc. 66A, 95(1953).

**Cl<sup>35</sup>**  
17 18       $\mu$       0.82111      I  
 $\nu(Cl^{35})/\nu(Rb^{85}) = 1.01481 \pm 0.00005$   
 $\mu(Cl^{35})/\mu(Cl^{37}) = 1.20128 \pm 0.00008$   
LiCl, RbCl  
Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

**Cl<sup>37</sup>**  
17 20       $\mu$       0.68352      I  
 $\nu(Cl^{37})/\nu(Rb^{85}) = 0.84477 \pm 0.00005$   
LiCl, RbCl  
Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

**K<sup>42</sup>**  
19 23      I      2  
 $\mu$       -1.137  
 $\Delta F = \pm 1$ ,  $\Delta m = \pm 1$  transitions studied  
 $\Delta\nu(K^{42})/\Delta\nu(K^{39}) = 1258.9/461.75$   
 $\mu(K^{39}) = 0.391$   
E.H.Bellamy, K.F.Smith, Phil. Mag. 44, 33(1953).

**Ca<sup>45</sup>**  
20 25       $\tau$       164<sup>d</sup>      Ca(pile n)  
C.F.G.Delaney, J.H.J.Pool, Phys. Rev. 89, 529  
(1953).

**Sc<sup>41</sup>**  
21 20       $\tau$       0.873<sup>s</sup>      Ca(30-Mev p) scin  
W.M.Martin, S.W.Breckon, Can. J. Phys. 30, 643  
(1952)

**Sc<sup>46</sup>**  
21 25       $\beta^- \leq 0.1\%$        $\leq 1.2$   
85<sup>d</sup>       $\gamma$       (0.88)       $\alpha = 1.9 \times 10^{-4}$   
              (1.11)       $\alpha = 0.88 \times 10^{-4}$   
J.A.Whalen, F.T.Porter, G.S.Cook, Phys. Rev.  
89, 902A(1953).

$\gamma$       (0.88)       $\tau < 2^{4s}$        $\beta\gamma$   
              (1.11)       $\tau < 2^{4s}$        $\beta\gamma$   
S.Koicki, R.Ballini, R.Chaminade, Compt. rend.  
236, 1155(1953).

$\gamma$       0.885      Sc(pile n)  
              1.119      sm 2 pe-  
T.Lindquist, Arkiv Fysik 6, 123(1953).

Capture  $\gamma$ 's      Sc<sup>45</sup>(n, $\gamma$ )      pair s  
2<sup>+</sup>      6.35      5<sup>+</sup>      8.18  
2.5<sup>+</sup>      6.84      1<sup>+</sup>      8.31  
0.7<sup>+</sup>      7.15      2.5<sup>+</sup>      8.54  
1<sup>+</sup>      7.65      0.3<sup>+</sup>      8.85  
+ Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386  
(1953).

Tl      Capture  $\gamma$       Tl(n, $\gamma$ )      pair s  
1.4<sup>+</sup>      4.67  
Isotopic assignment uncertain  
+ Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375  
(1953).

Tl<sup>48</sup>  
22 26      Capture  $\gamma$ 's      Tl(n, $\gamma$ )      pair s  
1.5<sup>+</sup>      7.38 ?  
0.4<sup>+</sup>      8.27 ?  
0.1<sup>+</sup>      9.39 ?  
Assignment assuming n binding = 11.63,  
9.39 $\gamma$  to 2.31 $\beta$  decay level

+ Photons per 100 n captures in Tl  
B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375  
(1953).

<b>Ti<sup>49</sup></b>	Capture $\gamma$ 's	Ti(n, $\gamma$ )	pair s
22 27	5 <sup>+</sup>	4.88	
	3.5 <sup>+</sup>	4.96	
	0.4 <sup>+</sup>	5.65 ?	
	32 <sup>+</sup>	6.412	
	4 <sup>+</sup>	6.53	
	53 <sup>+</sup>	6.756	

Assignment from agreement with d,p results  
† Photons per 100 n captures in Ti

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

<b>Ti<sup>50</sup></b>	Capture $\gamma$ 's	Ti(n, $\gamma$ )	pair s
22 28	53 <sup>+</sup>	6.756 ? (also Ti <sup>49</sup> )	
	0.8 <sup>+</sup>	7.80 ?	
	0.2 <sup>+</sup>	9.19 ?	

Assignment assuming n binding = 10.8,  
0.19 $\gamma$  to 1.58 d,p level

† Photons per 100 n captures in Ti

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

<b>Ti<sup>51</sup></b>	$\tau$	5.79 <sup>M</sup> ± 0.03	Ti(pile n)
Counted for 8 half-lives in $\beta$ electroroscope			

B.W.Sargent, L.Yaffe, A.P.Gray, Can. J. Phys. 31, 235(1953).

$\tau$  5.9<sup>M</sup>

Mass assignment confirmed by

Ca<sup>48</sup>(20-Mev  $\alpha$ ), Ti<sup>50</sup>(slow n),

Cr<sup>51</sup>(fast n), V<sup>51</sup>(fast n)

W.R.Hammond, D.N.Kundu, M.L.Pool, Phys. Rev. 90, 157(1953).

<b>V<sup>46</sup></b>	$\tau$	0.40 <sup>S</sup>	Ti(15-Mev p)
23 23	$\beta^+$	~6	scin bias

W.M.Martin, S.W.Breckon, Can. J. Phys. 30, 643 (1952).

<b>V<sup>51</sup>?</b>	Capture $\gamma$ 's	V(n, $\gamma$ )	pair s
23 28	0.3 <sup>+</sup>	7.67	
	1.3 <sup>+</sup>	7.83	
	0.5 <sup>+</sup>	7.98	

$E_{\gamma}$  greater than V<sup>51</sup> n binding

$\gamma$  intensity implies  $\sigma_a(V^{50}) = 40 - 400$

† Photons per 100 n captures in V

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386 (1953).

<b>V<sup>52</sup></b>	$\tau$	3.76 <sup>M</sup> ± 0.02	V <sup>51</sup> (pile n)
Counted for 5 half-lives in $\beta$ electroscope			

B.W.Sargent, L.Yaffe, A.P.Gray, Can. J. Phys. 31, 235(1953).

Levels	V <sup>51</sup> (d,p)	$E_d = 7.8$	ppl
d,p( $\theta$ )	g.s.	$l_n = 1 (> 75\%)$ , 3 (< 25%)	
	(0.79)	$l_n = 1$	
	(1.8)	$l_n = 1$	

J.S.King, W.C.Parkinson, Phys. Rev. 89, 1080 (1953); BAPS 28, 1, W9(1953).

<b>V<sup>52</sup></b>	Capture $\gamma$ 's	V(n, $\gamma$ )	pair s
23 29	2 <sup>+</sup>	3.39	
	3 <sup>+</sup>	3.59	
	3 <sup>+</sup>	3.73	
	4 <sup>+</sup>	4.15	
	3 <sup>+</sup>	4.45	
	2 <sup>+</sup>	4.85	
	2 <sup>+</sup>	4.98	18.5 <sup>+</sup>
	6 <sup>+</sup>	5.21	11 <sup>+</sup>

† Photons per 100 n captures in V

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386 (1953).

<b>Cr</b>	Capture $\gamma$ 's	Cr(n, $\gamma$ )	pair s
	0.5 <sup>+</sup>	3.72	
	0.8 <sup>+</sup>	4.83	
	1 <sup>+</sup>	5.26	
	2 <sup>+</sup>	5.61	
	1 <sup>+</sup>	6.00	
	0.7 <sup>+</sup>	6.12	
	0.9 <sup>+</sup>	6.26	7 <sup>+</sup>
	0.3 <sup>+</sup>	6.358	

Isotopic assignment uncertain

† Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

<b>Cr<sup>51</sup></b>	$\gamma$	0.330	ppl
No lower energy $\gamma$			

A.L.Cockcroft, quoted by S.C.Curran, Physica 18, 1161(1953).

<b>Cr<sup>53</sup></b>	Levels	Cr <sup>52</sup> (d,p)	$E_d = 10.2$	DPL
24 29	0.54	3.20		
	0.97	3.65		
	1.29	4.10		
	2.66			

C.E.McFarland, M.W.Bretschner, F.B.Shull, Phys. Rev. 89, 892A(1953).

Capture $\gamma$ 's	Cr(n, $\gamma$ )	pair s
3 <sup>+</sup>	7.364	
7 <sup>+</sup>	7.929	

Assignment from agreement with d,p results

† Photons per 100 n captures in Cr

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

No reaction	Fe(th n, $\sigma$ )	$\sigma < 10^{-5}$	ppl
	H.Faraggi, J. phys. radium 14, 160(1953).		

<b>Cr<sup>54</sup></b>	Capture $\gamma$ 's	Cr(n, $\gamma$ )	pair s
24 30	19 <sup>+</sup>	8.881	
	7 <sup>+</sup>	9.716	

Assignment from masses and Mn<sup>54</sup> 0.835Y

† Photons per 100 n captures in Cr

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

Mn <sup>50</sup> 25 25	$\tau$	0.28 <sup>S</sup>	Cr(17-Mev p)
	$\beta^+$	$\sim 6.3$	scin bias
W.M.Martin, S.W.Breckon, Can. J. Phys. 30, 643 (1952).			

Mn <sup>55</sup> 25 30	Q	$\sim 0.5$	Mic
	A.Javan, G.Silvey, C.H.Townes, A.V.Grosse, BAPS 28, 2, J8(1953).		
R.M.Bartholomew, R.C.Hawkins, W.F.Merritt, L.Yaffe, Can. J. Chem. 31, 204(1953).			

Mn <sup>56</sup> 25 31	$\tau$	$2.576^h \pm 0.002$	Mn(th n)
	Counted for 11 half-lives		47 <sup>T</sup> counter
R.M.Bartholomew, R.C.Hawkins, W.F.Merritt, L.Yaffe, Can. J. Chem. 31, 204(1953).			

$\tau$	$2.574^h \pm 0.003$	Mn(pile n)
Counted for 4 half-lives with $\beta$ electroscope		

E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3, 14(1953).

Capture $\gamma$ 's	Mn <sup>55</sup> (n, $\gamma$ )	pair s
1 <sup>+</sup>	3.82	0.3 <sup>+</sup> 5.63
1 <sup>+</sup>	4.10	1 <sup>+</sup> 5.77
2 <sup>+</sup>	4.24	0.5 <sup>+</sup> 5.91
2 <sup>+</sup>	4.55	1 <sup>+</sup> 6.11
2 <sup>+</sup>	4.72	0.5 <sup>+</sup> 6.43
2 <sup>+</sup>	4.81	2.5 <sup>+</sup> 6.779
6 <sup>+</sup>	5.04	6.5 <sup>+</sup> 7.048
3 <sup>+</sup>	5.21	4 <sup>+</sup> 7.15
4 <sup>+</sup>	5.53	12 <sup>+</sup> 7.261

<sup>†</sup>Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386 (1953).

Fe	$\gamma$ 's	Fe(n,n $\gamma$ )	$E_n = 14$	scin
	3.3			
	4.4			
	5.8			
	7.1			
	8.75			

Spectrum continuous below 3 Mev

V.E.Scherrer, R.Theus, W.R.Faust, Phys. Rev. 89, 1268(1953).

Capture $\gamma$ 's	Fe(n, $\gamma$ )	pair s
2.0 <sup>+</sup>	3.43	
0.5 <sup>+</sup>	3.86	
2 <sup>+</sup>	4.21	
1 <sup>+</sup>	4.44	
1 <sup>+</sup>	4.81	
0.4 <sup>+</sup>	6.369	

Isotopic assignment uncertain

<sup>†</sup>Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

Fe <sup>55</sup> 26 29	$E_{dis}$	0.20	scin
from continuous $\gamma$ endpoint			

P.Bolgiano, L.Wadansky, F.Rasetti, Phys. Rev. 89, 679(1953).

E <sub>dis</sub>	0.22	scin
from continuous $\gamma$ endpoint		

A.Michalowicz, J. phys. radium 14, 214(1953).

Fe <sup>55</sup> 26 29	No e <sup>-</sup> ( $< 6 \times 10^{-5} \%$ ) between 0.080 and 0.20 Mn <sup>55</sup> (10-Mev d,2n) chem
F.T.Porter, H.P.Hotz, Phys. Rev. 89, 938(1953).	

Capture $\gamma$ 's	Fe(n, $\gamma$ )	pair s
0.8 <sup>+</sup>	8.345	
0.5 <sup>+</sup>	8.872	
2.7 <sup>+</sup>	9.298	(also Fe <sup>58</sup> ?)
Assignment from agreement with d,p and p,n results		
<sup>†</sup> Photons per 100 n captures in Fe		
B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).		

Fe <sup>56</sup> 26 30	$\gamma$	Fe(n,ny)	$E_n = 1.23$ scin
(0.85)			

B.Rose, J.W.Freeman, Proc. Phys. Soc. 66A, 120 (1953).

$\gamma$ 's	Fe(n,ny)	pair s
0.85		
1.25		

L.C.Thompson, Phys. Rev. 89, 905A(1953).

$\gamma$ 's	Fe(n,ny)	pair s
0.85		
1.25		
1.42	(Fe <sup>57</sup> ?)	

R.B.Day, Phys. Rev. 89, 908A(1953).

Fe <sup>57</sup> 26 31	Capture $\gamma$ 's	Fe(n, $\gamma$ )	pair s
	0.5 <sup>+</sup>	4.968	
	5.2 <sup>+</sup>	5.914	
	5.6 <sup>+</sup>	6.015	
	3.5 <sup>+</sup>	7.285	
	36 <sup>+</sup>	7.639	

Assignment from agreement with d,p results

<sup>†</sup>Photons per 100 n captures in Fe

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

Fe <sup>58</sup> 26 32	Capture $\gamma$ 's	Fe(n, $\gamma$ )	pair s
	2.7 <sup>+</sup>	9.298	(also Fe <sup>55</sup> ?)
	0.1 <sup>+</sup>	10.16	

Assignment from masses and Co<sup>58</sup> decay

<sup>†</sup>Photons per 100 n captures in Fe

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).

Fe <sup>59</sup> 26 33	$\gamma$	58 <sup>+</sup>	1.10	s $\pi$ cpt
		42 <sup>+</sup>	1.28	

No other  $\gamma$  (0.5 to 2.1) < 10%

B.S.Dzheliepov, N.N.Zhukovskii, V.V.Khol'nov, Doklady Akad. Nauk SSSR 86, 497(1952).

Co <sup>54</sup> 27 27	$\tau$	$\sim 0.18^S$	Fe(17-Mev p)
	$\beta^+$	$\sim 7.4$	scin bias
W.M.Martin, S.W.Breckon, Can. J. Phys. 30, 643 (1952).			

$\text{Co}^{57}$   
27 30 I 7/2 para  
 $\mu$  4.6

J.M.Baker, B.Bleaney, K.D.Bowers, P.F.D.Shaw,  
R.S.Trenam, Proc. Phys. Soc. 66A, 305(1953).

$\text{Co}^{58}$   
27 31 T 72<sup>d</sup> d 9.2<sup>h</sup>Co chem  
72<sup>d</sup>

D.C.Hoffman, D.S.Martin Jr., J. Phys. Chem. 56,  
1097(1952).

$\text{Co}^{60}$   
27 33 T<sub>2</sub> 4.95<sup>y</sup> ± 0.04 Co(pile n)  
5.2<sup>y</sup>

Counted for 8 months with  $\beta$  electroroscope  
E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3,  
14(1953).

$\gamma$  1.1728 K/LM~10 s<sup>77</sup> ce<sub>K</sub>  
1.3325 K/LM~10

Energy calibration from authors' new  
absolute measurement of 1.12 and  
1.41  $\gamma$ 's of  $\text{Bi}^{214}$

G.Lindström, A. Hedgran, D.E.Alburger, Phys.  
Rev. 89, 1303(1953).

$\gamma\gamma(\theta)$ ,  $\gamma\gamma$  polarization-direction

I = 4+, 2+, 0+

J.J.Kraushaar, M.Goldhaber, Phys. Rev. 89, 1081  
(1953).

$\text{Co}^{60}$   
27 33 Capture  $\gamma$ 's  $\text{Co}^{59}$  (n,  $\gamma$ ) pair s

1 <sup>+</sup>	3.36	5.6 <sup>+</sup>	5.966
0.7 <sup>+</sup>	3.69	0.5 <sup>+</sup>	6.11
1 <sup>+</sup>	4.03	0.7 <sup>+</sup>	6.250
0.8 <sup>+</sup>	4.18	5 <sup>+</sup>	6.474
1 <sup>+</sup>	4.37	8 <sup>+</sup>	6.690
0.6 <sup>+</sup>	4.59	7 <sup>+</sup>	6.867
2.5 <sup>+</sup>	4.903	2.5 <sup>+</sup>	6.97
2 <sup>+</sup>	5.18	1.3 <sup>+</sup>	7.04
0.7 <sup>+</sup>	5.35	4.0 <sup>+</sup>	7.201
6.3 <sup>+</sup>	5.646	3.0 <sup>+</sup>	7.486
1.7 <sup>+</sup>	5.73		

+ Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386  
(1953).

Ni

Capture  $\gamma$ 's Ni(n,  $\gamma$ ) pair s

3 <sup>+</sup>	5.82	9 <sup>+</sup>	6.84
0.3 <sup>+</sup>	5.99	0.5 <sup>+</sup>	7.05
1.0 <sup>+</sup>	6.10	0.5 <sup>+</sup>	7.22
0.6 <sup>+</sup>	6.34	2.8 <sup>+</sup>	8.12
2.0 <sup>+</sup>	6.58		

+ Isotopic assignment uncertain  
Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 386  
(1953).

Ni<sup>59</sup>  
28 31 Levels Ni<sup>58</sup> (d,p) E<sub>d</sub> = 10.2 ppl

0.42	5.20
3.08	5.66
4.57	

C.E.McFarland, W.W.Bretschner, F.B.Shull, Phys.  
Rev. 89, 892A(1953).

28 Ni<sup>59</sup> 31 Capture  $\gamma$ 's Ni(n,  $\gamma$ ) pair s

1 <sup>+</sup>	5.31
0.4 <sup>+</sup>	5.70
14 <sup>+</sup>	8.532 (also Ni <sup>61</sup> ?)
35 <sup>+</sup>	8.997

Assignment from agreement with d,p results  
+ Photons per 100 n captures in Ni

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375  
(1953).

28 Ni<sup>61</sup> 33 Capture  $\gamma$ 's Ni(n,  $\gamma$ ) pair s

4 <sup>+</sup>	7.528
6.5 <sup>+</sup>	7.817
14 <sup>+</sup>	8.532 (also Ni <sup>59</sup> ?)

Assignment from agreement with d,p results  
and Cu<sup>61</sup> decay

+ Photons per 100 n captures in Ni

B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375  
(1953).

28 Ni<sup>63</sup> 35 F-K plot concave toward energy axis below  
30 kev although S<sup>35</sup> and Pm<sup>147</sup> plots linear  
to 10 kev

J.P.Mize, D.O.Zaffarano, BAPS 28, 2, DA 6(1953).

Cu Capture  $\gamma$ 's Cu(n,  $\gamma$ ) pair s

0.7 <sup>+</sup>	5.07	0.2 <sup>+</sup>	5.75
0.6 <sup>+</sup>	5.18	1 <sup>+</sup>	6.05
1 <sup>+</sup>	5.31	1 <sup>+</sup>	6.41
1 <sup>+</sup>	5.43	1 <sup>+</sup>	7.16
0.5 <sup>+</sup>	5.64		

Isotopic assignment uncertain  
+ Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386  
(1953).

29 Cu<sup>58</sup> 29  $\tau$  3.04<sup>s</sup> - Ni(15-Mev p)

W.W.Martin, S.W.Breckon, Can. J. Phys. 30, 643  
(1952).

29 Cu<sup>64</sup> 35 Capture  $\gamma$ 's Cu(n,  $\gamma$ ) pair s

3 <sup>+</sup>	6.69
2 <sup>+</sup>	7.01
5.5 <sup>+</sup>	7.296
20 <sup>+</sup>	7.914

Assignment from agreement with d,p results  
+ Photons per 100 n captures in Cu

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386  
(1953).

29 Cu<sup>66</sup> 37  $\tau$  5.10<sup>m</sup> Cu(slow n)

Counted with  $\beta$  electroscope

B.W.Sargent, L.Yaffe, A.P.Gray, Can. J. Phys.  
31, 235(1953).

Capture  $\gamma$  Cu(n,  $\gamma$ ) pair s

9 <sup>+</sup>	7.634 ?
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Assignment from agreement with unpublished  
d,p results, but disagrees with Zn<sup>66</sup> ( $\gamma$ , n)  
+ Photons per 100 n captures in Cu

G.A.Bartholomew, B.B.Kinsey, Phys. Rev. 89, 386  
(1953).

Zn	Capture $\gamma$ 's	Zn(n, $\gamma$ )	pair s	$^{78}\text{Ge}^{78}$	$\tau$	$^{86m}$	$^{235}\text{U}$ (pile n,f) chem; pc
	1.2 <sup>+</sup>	4.14	0.3 <sup>+</sup>	6.26			N. Sugarman, Phys. Rev. 89, 570(1953).
	1.6 <sup>+</sup>	4.84	1 <sup>+</sup>	6.49			
	0.7 <sup>+</sup>	5.23	0.5 <sup>+</sup>	6.65			
	2.5 <sup>+</sup>	5.48	2.7 <sup>+</sup>	6.94			
	1 <sup>+</sup>	5.77	2.0 <sup>+</sup>	7.19			
	0.8 <sup>+</sup>	6.03					
	Isotopic assignment uncertain						
	$^+ \text{Photons per 100 n captures}$						
	B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).						
$^{62}\text{Zn}$	$\tau$	$8.4^h$		$\text{Ni}(18\text{-Mev He}^3)$			
30 32							
	D.N.Kundu, T.W.Donavan, M.L.Pool, J.K.Long, Phys. Rev. 89, 1201(1953); Physica 18, 1304 (1952).						
$^{65}\text{Zn}$	$\gamma$	0.20?					
30 33		$1.11\gamma/\beta^+ = 38$	$0.20\gamma/\beta^+ = 0.5$				
	R.Bouchez, N.Perrin, quoted by R.Bouchez, Physica 18, 1171(1952).						
	Capture $\gamma$	Zn(n, $\gamma$ )	pair s				
	10 <sup>+</sup>	7.876					
	Assignment from agreement with d,p results						
	$^+ \text{Photons per 100 n captures in Zn}$						
	B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).						
$^{68}\text{Zn}$	Capture $\gamma$ 's	Zn(n, $\gamma$ )	pair s				
30 38							
	0.6 <sup>+</sup>	8.31					
	0.2 <sup>+</sup>	8.58					
	0.2 <sup>+</sup>	8.98					
	1 <sup>+</sup>	9.12					
	0.07 <sup>+</sup>	9.51					
	Assigned here since $E_\gamma > n$ binding in other Zn's						
	$^+ \text{Photons per 100 n captures in Zn}$						
	B.B.Kinsey, G.A.Bartholomew, Phys. Rev. 89, 375 (1953).						
$^{69}\text{Zn}$	$\gamma$	0.435	$\alpha = 0.06$	sl ce <sup>-</sup> , scin			
30 39							
13.8 <sup>h</sup>	R.B.Duffield, L.M.Langer, Phys. Rev. 89, 854 (1953).						
$^{52m}$	$\beta^-$	100%	0.897	sl			
	R.B.Duffield, L.M.Langer, Phys. Rev. 89, 854 (1953).						
$^{65}\text{Ga}$	$\tau$	15 <sup>m</sup>		$\text{Cu}(21\text{-Mev He}^3)$			
31 34	$\beta^+$	2.1					
	M.L.Pool, Physica 18, 1304(1952).						
	$\beta^+$	2.2		Zn(6-Mev d) chem; a			
	A.H.W.Aten, Jr., H.de Wijs, M.Boelhouwer, Physica 18, 1032(1952).						
$^{67}\text{Ga}$	$\gamma$	(0.092)	$\tau \sim 350\mu\text{s}$	scin			
31 36		(0.187)	(0.307)	$\text{Cu}(21\text{-Mev He}^3)$			
	M.L.Pool, Physica 18, 1304(1952).						
	$^{78}\text{Ge}^{78}$	$\tau$					
32 46							
	N. Sugarman, Phys. Rev. 89, 570(1953).						
$^{70}\text{As}$	$\tau$						
33 37	$\beta^+$						
	Ge(26-Mev d) chem a scin						
	$\gamma$						
	B.Verkerk, A.H.W.Aten, Jr., Physica 18, 974(1952); A.H.Wapstra, N.F.Verster, Ibid.						
	$K/\beta^+ < 0.2$ $\gamma/\beta^+ \sim 2$						
$^{75}\text{As}$	$\mu$						I
33 42							
	$\nu(\text{As}^{75})/\nu(0) = 1.11569 \pm 0.00005$						
	$\text{Na}_2\text{HAsO}_4$ , $\text{D}_2\text{O}$						
	Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).						
$^{76}\text{As}$	$\gamma$						
33 43							
	(E) 2 (M) 1 (20-60%) $\gamma\gamma(\theta)$						
	$\gamma$	0.56					
		0.65					
		1.21					
		2.1					
	(0.85 $\gamma$ ) (0.58 $\gamma$ ) ( $\theta$ ) I = 2,2,0 As (slow n) scin						
	J.J.Kraushaar, M.Goldhaber, Phys. Rev. 89, 1081 (1953).						
$^{77}\text{As}$	$\tau$						
33 44							
	38.0 <sup>h</sup> $^{235}\text{U}$ (pile n,f) chem; pc						
	N.Sugarman, Phys. Rev. 89, 570(1953).						
$^{78}\text{As}$	$\tau$						
33 45							
	91.0 <sup>m</sup> d $^{86m}\text{Ge}^{78}$ $^{235}\text{U}$ (pile n,f) chem; pc						
	No ~40 <sup>m</sup> activity observed						
	N.Sugarman, Phys. Rev. 89, 570(1953).						
$^{79}\text{Br}$	$\mu(\text{Br}^{81})/\mu(\text{Br}^{79}) = 1.07794$						M
35 44							
	$q$	0.335					
	$q(\text{Br}^{79})/q(\text{Br}^{81}) = 1.19707$						
	J.G.King, V.Jaccarino, BAPS 28, 2, DAL(1953).						
$^{81}\text{Br}$	$\mu(\text{Br}^{81})/\mu(\text{Br}^{79}) = 1.07794$						M
35 46							
	$q$	0.280					
	$q(\text{Br}^{79})/q(\text{Br}^{81}) = 1.19707$						
	J.G.King, V.Jaccarino, BAPS 28, 2, DAL(1953).						
$^{87}\text{Br}$	$n$	2%					
35 52	$\beta^-$	70%	2.6				
		30%	8.0				
	$\gamma$	80 <sup>+</sup>	2 - 4				
		20 <sup>+</sup>	5.4				
	A.F.Stehney, N.Sugarman, Phys. Rev. 89, 194(1953).						
$^{82}\text{Rb}$	$\tau$						
37 45	$\beta^+$						
	76 <sup>s</sup> d 25.5 <sup>d</sup> Sr a						
		4.2					
	$\beta^+$ observed in 25.5 <sup>d</sup> Sr but assigned here						
	P.Kruger, N.Sugarman, Phys. Rev. 90, 158(1953).						

<b>Rb<sup>84</sup></b>	$\tau_1$	<b>21<sup>m</sup></b>	Rb(fast n)	ion chem
37 47	$\gamma$	<b>25<sup>+</sup></b> 0.239	scin	
23 <sup>m</sup>		<b>10<sup>+</sup></b> 0.463		
	(0.23 $\gamma$ ) (0.23 $\gamma$ ) No	(0.23 $\gamma$ ) (0.46 $\gamma$ )	scin	
	No x rays observed		DC	
	R.S.Caird, A.C.G.Mitchell, Phys. Rev. 89, 573 (1953).			

<b>Sr<sup>82</sup>?</b>	$\tau$	<b>25.5<sup>d</sup></b>	Ag(450-Mev p)	chem
38 44	Parent	76 <sup>s</sup> Rb; not p 6.3 <sup>h</sup> Rb (< 1%)		chem
	P.Kruger, N.Sugarman, Phys. Rev. 90, 158 (1953).			

<b>Sr<sup>89</sup></b>	Levels	<b>Sr(d,p)</b>	$E_d = 10.4$	s
38 51		<b>1.07</b>		
		<b>2.07</b>		
		<b>2.54</b>		

C.E.McFarland, F.B.Shull, Phys. Rev. 89, 489 (1953).

<b>Sr<sup>91</sup></b>	$\beta^-$	<b>7%</b> 0.62	U(n,f)	s $\pi$
38 53		<b>33%</b> 1.093		
		<b>29%</b> 1.355		
		<b>5%</b> 2.03		
	$\gamma$	<b>26%</b> 2.665 $\Delta I = 2$ , yes shape		
		<b>0.5512</b> K/LM = 6.0		
		<b>0.63</b>		
		<b>0.747</b>		
		<b>1.025</b>		
		<b>1.413</b>		

D.P.Ames, M.E.Bunker, L.W.Langer, B.M.Sorenson, Phys. Rev. 89, 903A (1953).

<b>Y<sup>91</sup></b>	$\tau_1$	<b>50.3<sup>m</sup></b>	d 9.7 <sup>h</sup> Sr	
39 52			D.P.Ames, M.E.Bunker, L.W.Langer, B.M.Sorenson, Phys. Rev. 89, 903A (1953).	
51 <sup>m</sup>				
			F.I.Boley, D.S.Dunavan, Phys. Rev. 90, 158 (1953).	

<b>Y<sup>92</sup></b>	$\tau_2$	<b>61<sup>d</sup></b>		
39 53	$\beta^-$	<b>1.54</b> $\Delta I = 2$ , yes shape	scin	
		1.16 $\gamma$ observed with $\tau \sim 160^d$	NO(1.16 $\gamma$ ) ( $\beta$ )	
			F.I.Boley, D.S.Dunavan, Phys. Rev. 90, 158 (1953).	

Continuous  $\gamma$  spectrum scin  
 $\gamma(E_\gamma > 0.09) / \beta^- = 0.0019$   
P.Bogliano, L.Madansky, F.Rasetti, Phys. Rev. 89, 679 (1953).

<b>Y<sup>92</sup></b>	Mass assignment of 3.5 <sup>h</sup> activity confirmed from Zr(7.8-Mev d, $\alpha$ ) yields			
39 53	G.L.Schott, W.W.Meinke, Phys. Rev. 89, 1156 (1953).			

<b>Y<sup>94</sup></b>	Mass assignment of 16.5 <sup>m</sup> activity confirmed from Zr(7.8-Mev d, $\alpha$ ) yields			
39 55	G.L.Schott, W.W.Meinke, Phys. Rev. 89, 1156 (1953).			

<b>Zr<sup>89</sup></b>	$\tau_1$	<b>4.25<sup>m</sup></b>	Zr( $\leq 24$ -Mev $\gamma$ )	
40 49	L.Katz, R.G.Baker, R.Montalbetti, Can. J. Phys. 31, 250 (1953).			
4.5 <sup>m</sup>				
<b>80<sup>h</sup></b>	$\tau_2$	<b>78<sup>h</sup></b>	Zr( $\leq 24$ -Mev $\gamma$ )	
	L.Katz, R.G.Baker, R.Montalbetti, Can. J. Phys. 31, 250 (1953).			

<b>Zr<sup>95</sup></b>	$\beta^-$	<b>89%</b>	<b>0.370</b>	Zr(pile n) ion chem
40 55		<b>1%</b>	<b>0.84</b>	s
			<b>0.721</b>	$\alpha = 0.0024$ s $pe^-$ , $ce^-$
			<b>0.92</b> $\gamma$	H.Silatis, L.Zappa, Arkiv Fysik 6, 81 (1953).
	$\beta^-$	<b>54%</b>	<b>0.364</b>	s
		<b>43%</b>	<b>0.396</b>	
	$\gamma$	<b>0.722</b>	$\alpha_K = 0.0014^*$	s $ce^-$
		<b>0.754</b>	$\alpha_K = 0.0011^*$	
	$\beta\gamma$ ( $\theta$ )	$b = 0.00 \pm 0.03$		
			P.S.Mittelman, BAPS 28, 3, U10 (1953); *verbal report.	
	$\gamma$	<b>0.73</b>	U(n,f) chem; scin	
		( $\beta$ ) (0.73 $\gamma$ ) indicates $\gamma/\beta \sim 1$		
			C.E.Mandeville, E.Shapiro, R.I.Mendenhall, E.R.Zucker, G.L.Conklin, Phys. Rev. 89, 559 (1953).	
	<b>Mb<sup>90</sup></b>	<b>14.7<sup>h</sup></b>	d 5.7 <sup>h</sup> Mo chem	
41 49	$\beta^+$	<b>1.2</b>	Al a	
		Absorption due to x rays, $\beta^+$ or both		
		R.M.Diamond, Phys. Rev. 89, 1149 (1953).		
	<b>Mb<sup>95</sup></b>	<b>84<sup>h</sup></b>	d 65 <sup>d</sup> Zr chem	
41 54	$\tau_1$	<b>0.231</b>	s $ce^-$	
90 <sup>h</sup>			H.Silatis, L.Zappa, Arkiv Fysik 6, 81 (1953).	
	$\beta^-$	<b>0.159</b>	d 65 <sup>d</sup> Zr chem	
35 <sup>d</sup>	$\gamma$	<b>0.745</b>	$\alpha = 0.0024$ s; $ce^-$	
		H.Silatis, L.Zappa, Arkiv Fysik 6, 81 (1953).		
	$\beta^-$	<b>0.171</b>		sI
	$\gamma$	<b>0.771</b>	$\alpha = 0.0018$ K/LM = 2.4*	
		E.F.Strucken, A.H.Weber, BAPS 28, 3, U11 (1953); *verbal report.		
	$\gamma$	<b>0.774</b>	K/LM = 6.6 s $ce^-$	
		R.E.Maerker, R.O.Birkhoff, Phys. Rev. 89, 1159 (1953).		
	$\gamma$	<b>0.76</b>	d 65 <sup>d</sup> Zr chem; scin	
		( $\beta$ ) (0.76 $\gamma$ ) indicates $\gamma/\beta \sim 1$		
		C.E.Mandeville, E.Shapiro, R.I.Mendenhall, E.R.Zucker, G.L.Conklin, Phys. Rev. 89, 559 (1953).		
	$\gamma$	<b>0.764</b>	s $ce^-$	
		P.S.Mittelman, BAPS 28, 3, U10 (1953).		
	<b>Mo<sup>90</sup></b>	<b>5.7<sup>h</sup></b>	Nb <sup>93</sup> (55-Mev p) chem	
42 48	$\beta^+$	<b>~1.4?</b> *	Al a	
	$\gamma$	<b>~0.12</b>	Pb a	
		<b>~0.25</b>	I.I.	
			*Absorption due to x rays, $\beta^+$ or both	
			R.M.Diamond, Phys. Rev. 89, 1149 (1953).	
	<b>Mo<sup>91</sup></b>	<b>65.5<sup>h</sup></b>	- Mo(< 24-Mev $\gamma$ )	
42 49	$\sigma$ (65.5 $\gamma$ ) / $\sigma$ (15.5 $m$ ) = 0.2 for $E_\gamma = 16-20$			
75 <sup>s</sup>	indicating 65.5 $\gamma$ state has larger spin			
	L.Katz, R.G.Baker, R.Montalbetti, Can. J. Phys. 31, 250 (1953).			

$^{42}_{\text{Mo}} \text{Mo}^{91}$  No  $85.5^{\circ}$  activity from Mo (14.4-Mev  $n, 2n$ ); weak activity from Mo (18-Mev  $n, 2n$ )  
 $75^{\circ}$   
J.E.Brolley, Jr., Phys. Rev. 89, 877(1953); 88, 618(1952).

$^{16m}_{\text{Mo}}$   $\tau_1 = 15.5^m$  Mo ( $\leq 24$ -Mev  $\gamma$ )  
 $\beta^+$   $3.3$  a  
 $65.5^{\circ}$  level  $0.15 \pm 0.05$  Mev above  $15.5^m$   
g.s. from Mo( $\gamma, n$ ) thresholds  
L.Katz, R.G.Baker, R.Montalbetti, Can. J. Phys. 31, 250(1953).

$^{42}_{\text{Mo}} \text{Mo}^{93}$  Mass assignment of  $6.7^h$  activity confirmed  
with ms Nb (6.7-Mev d) chem  
 $6.7^h$   
 $\gamma$   $0.27$  scin  
 $0.70$   
 $1.5$

R.Bernas, J.Beydon, Compt. rend. 236, 194(1953).

Mass assignment of  $6.7^h$  activity confirmed  
with ms Nb (25-Mev d)  
 $\gamma$   $0.264$  K/LM=2.8 L/M $\sim 3$   $s\pi/2 ce^-$   
 $0.685$  pe $^-$   
 $1.479$  pe $^-$

D.E.Alburger, S.Thulin, Phys. Rev. 89, 1146(1953).

$^{43}_{\text{Tc}} \text{Tc}^{93}$   $\tau_1 = 43.5^m$  Mo $^{92}$  (9.5-Mev p) chem  
 $44^m$   $\gamma$   $0.390$   $\alpha_K = 0.31$  K/LM=5.8 M4  
 $s\pi/2 ce^-, pe^-$   
Assignment from Nb $^{93}$  (39-Mev a),  
Mo (~0 to 20-Mev d); formerly assigned to  
Tc $^{92}$

H.T.Easterday, H.A.Medicus, Phys. Rev. 89, 752  
(1953).

$^{43}_{\text{Tc}} \text{Tc}^{96}$   $\tau_1 = 52^m$  Nb $^{93}$  (13.5-Mev a)  $s\pi/2 ce^-$   
 $52^m$   $\beta^+ \sim 0.01%$   
 $\gamma$  I.T.  $0.034$  K/L=1.2  
Assignment from Mo $^{96}$  (9.5-Mev p), Mo (4-Mev p);  
formerly assigned to Tc $^{94}$

H.T.Easterday, H.A.Medicus, Phys. Rev. 89, 752  
(1953).

$^{44}_{\text{Ru}} \text{Ru}^{103}$   $\gamma$   $(0.499)$   $\tau < 2 \times 10^{-9s}$   $\beta\gamma$   
 $59$   
T.C.Engelder, Phys. Rev. 90, 259(1953).

$^{45}_{\text{Rh}} \text{Rh}^{97?}$   $\tau = 31^m$  Ru (28-Mev d) chem  
 $\beta^+$   
A.H.W.Aten, Jr., H.Cerfontain, W.Dzubas, T.Hamerling, Physica 18, 972(1952).

$^{45}_{\text{Rh}} \text{Rh}^{98?}$   $\tau$   $9^m$  Ru (28-Mev d) chem  
 $\beta^+$   
A.H.W.Aten, Jr., H.Cerfontain, W.Dzubas, T.Hamerling, Physica 18, 972(1952).

$^{45}_{\text{Rh}} \text{Rh}^{106}$   $\gamma$   $100 \pm$   $0.51$   
 $53 \pm$   $0.62$   
 $2 \pm$   $0.87$   
 $7 \pm$   $1.04$   
 $1 \pm$   $1.55$

( $0.62\gamma$ ) ( $0.51\gamma$ ) ( $\theta$ ) and polarization-  
direction  $I = 0+, 2+, 0+$   
 $\gamma\gamma(\theta)$  coefficients 12% lower than theory

J.J.Kraushaar, M.Goldhaber, Phys. Rev. 89, 1081  
(1953).

$^{46}_{\text{Pd}} \text{Pd}^{105}$  I  $5/2$  S  
 $59$   
J.Blaize, H.Chantrel, J. phys. radium 14, 135  
(1953).

$^{47}_{\text{Ag}} \text{Ag}^{107}$   $\mu(\text{Ag}^{107})/\mu(\text{Ag}^{109}) = 0.86627$  M  
G.Wessel, H.Lew, BAPS 28, 3, Q8(1953).

$^{47}_{\text{Ag}} \text{Ag}^{109}$   $\mu(\text{Ag}^{107})/\mu(\text{Ag}^{109}) = 0.86627$  M  
G.Wessel, H.Lew, BAPS 28, 3, Q8(1953).

$^{47}_{\text{Ag}} \text{Ag}^{110}$   $(0.53\beta)(0.66\gamma)$  ( $0.53\beta)(0.89\gamma)$  ( $0.53\beta)(0.94\gamma)$   
No ( $0.53\beta)(1.52\gamma$ ) No ( $0.53\beta)(1.39\gamma$ )  
( $0.68\gamma)(0.89\gamma$ ) ( $0.68\gamma)(0.94\gamma$ ) ( $0.68\gamma)(1.39\gamma$ )  
( $0.89\gamma)(0.94\gamma$ ) ( $0.89\gamma)(1.39\gamma$ )  
( $1.52\gamma)(0.68\gamma$ ) ( $1.52\gamma)(0.76\gamma$ ) No ( $1.52\gamma)(0.89\gamma$ )

Results in agreement with Siegbahn decay scheme

S.A.E.Johansson, S.Almquist, Arkiv Fysik 5, 427  
(1952).

$^{47}_{\text{Ag}} \text{Ag}^{111}$   $\bar{\beta} = 0.376 \pm 0.014$  ic  
 $64$   
J.M.Brabant, L.W.Cochran, R.S.Caswell, BAPS 28,  
2, DA5(1953).

$^{48}_{\text{Cd}} \text{Cd}^{111}$  Levels  $Cd(n, n') 49^m Cd$   $E_n = 0.1$  to  $1.4$   
 $63$   
 $0.72$   
 $0.95?$   
 $1.15$

Absolute  $\sigma$  consistent with  $I = 11/2$  for  
 $49^m Cd$  from statistical model

A.E.Francis, J.J.McCue, C.Goodman, Phys. Rev.  
89, 1232(1953).

$^{48}_{\text{Cd}} \text{Cd}^{117}$   $\tau_1 = 3.0^h$   $Cd(n, \gamma)$   $Cd(d, p)$   $U(n, f)$   
 $2.8h$   $\beta$  weak if present  
C.D.Coryell, P.Léveque, H.G.Richter, Phys. Rev.  
89, 903A(1953).

$\sim 50^m$   $\tau_2 = 50^m$   $Cd(n, \gamma)$   $Cd(d, p)$   $U(n, f)$   
 $\beta$  and  $\gamma$   $p \sim 2^h In ?$   
C.D.Coryell, P.Léveque, H.G.Richter, Phys. Rev.  
89, 903A(1953).

$^{48}_{\text{Cd}} \text{Cd}^{118}$   $\tau = 30^m$  U(n,f)  
 $\beta^-$  a  
Not p  $4.5^m In$   
C.D.Coryell, P.Léveque, H.G.Richter, Phys. Rev.  
89, 903A(1953).

<sup>49</sup>In<sup>111</sup>  $\gamma\gamma(\theta)$   $b = -0.19$  liquid sample  
b depends on phase not chemical structure  
R.W.Steffen, Phys. Rev. 89, 903A(1953).

<sup>49</sup>In<sup>113</sup>  $\mu$  5.4966 In(NO<sub>3</sub>)<sub>3</sub>; I  
 $\nu(\text{In}^{113})/\nu(\text{In}^{115}) = 0.99787 \pm 0.00004$   
Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

<sup>49</sup>In<sup>114</sup>  $\beta^-$  2.01 50<sup>d</sup>In; s  
V.S.Shpinel, N.V.Forafontov, Zhur. Eksptl. i Teoret. Fiz. 21, 1376(1951).

<sup>49</sup>In<sup>115</sup>  $\mu$  5.5083 In(NO<sub>3</sub>)<sub>3</sub> ScCl<sub>3</sub>; I  
 $\nu(\text{In}^{115})/\nu(\text{Sc}^{45}) = 0.901877 \pm 0.00005$   
Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

<sup>49</sup>In<sup>116</sup>  $\tau_1$  54.14<sup>m</sup> ± 0.07 In(pile n)  
Counted for 5 half-lives with G-M  
K.W.Downes, G.A.Price, R.Sher, V.J.Walsh,  
BNL-216 (T-33).

<sup>49</sup>In<sup>117</sup>  $\tau_1$  70<sup>m</sup> U(n,f)  
 $\beta^-$  and weak  $\gamma$   
C.D.Coryell, P.Lévéque, H.G.Richter, Phys. Rev. 89, 903A(1953).

$\sim 2.5^h$   $\tau_2$  ~2.5<sup>h</sup> U(n,f)  
 $\beta^-$  and very weak  $\gamma$   
C.D.Coryell, P.Lévéque, H.G.Richter, Phys. Rev. 89, 903A(1953).

<sup>49</sup>In<sup>118</sup>  $\tau_2$  <1<sup>m</sup> d 30<sup>m</sup>Cd chem  
 $\beta^-$  4.0 a  
C.D.Coryell, P.Lévéque, H.G.Richter, Phys. Rev. 89, 903A(1953).

$\tau_1$  53.99<sup>m</sup> ± 0.06 In(pile n)  
Counted for 8 half-lives with  $\beta$  electro-  
scope

E.E.Lockett, R.H.Thomas, Nucleonica 11, No. 3, 14(1953).

<sup>50</sup>Sn<sup>113</sup>  $\tau$  120<sup>d</sup> Sn(pile n) chem  
No 0.255 $\gamma$  (<1% of 0.392 $\gamma$ ) scin  
No 0.401 $\gamma$  (<10% of 0.392 $\gamma$ )

Y.Deschamps, P.Avignon, Compt. rend. 236, 478 (1953).

No e<sup>-</sup>(0.085 $\gamma$ ) <1% of e<sup>-</sup>(0.392 $\gamma$ ) sl  
No e<sup>-</sup>(0.255 $\gamma$ ) <1% of e<sup>-</sup>(0.392 $\gamma$ )  
e<sup>-</sup>(0.401 $\gamma$ ) not resolvable  
 $e_A^-/e_K^-$ (0.392 $\gamma$ ) = 0.56

$\epsilon_L/\epsilon_K = 0.08$  to 0.17 (if all  $\epsilon$  to 0.392 level)  
Previous value of 0.8 superseded

C.D.Broyles, D.A.Thomas, S.K.Haynes, Phys. Rev. 89, 715(1953).

<sup>51</sup>Sb<sup>121</sup> q -1.3 s  
G.Sprague, D.H.Tomboulian, BAPS 28, 3, 011(1953).

<sup>51</sup>Sb<sup>123</sup> q -1.7 s  
G.Sprague, D.H.Tomboulian, BAPS 28, 3, 011(1953).

<sup>51</sup>Sb<sup>124</sup>  $\beta^-$  14% 0.24 s  
49% 0.61  
60<sup>d</sup> 9% 0.966  
7% 1.602  
21% 2.317 F-K plot not linear  
2.3 $\beta$   $\Delta I = 1$ , yes ? Not  $\Delta I = 2$ , yes  
0.603  $\alpha = 0.0034$  K/LM=7.9 E2 ce<sup>-</sup>  
0.641 pe<sup>-</sup>  
0.716  
1.68  
2.09  
(1.68 $\gamma$ ) (0.60 $\gamma$ ) \* (2.09 $\gamma$ ) (0.60 $\gamma$ ) \*

R.J.D.Moffat, N.Lazar, L.M.Langer, BAPS 28, 3, 013(1953); \*Verbal report.

$\beta^-$  10% 0.223 s  
53% 0.609  
8% 0.871  
5% 1.581  
5% 1.658 F-K plot not linear  
21% 2.306 F-K plot not linear  
2.3 $\beta$   $\Delta I = 2$ , no ? Not  $\Delta I = 2$ , yes  
 $\gamma$  Rel. intensity of ce<sup>-</sup>  
0.604 K : L : M = 100 : 13 : 3  
0.648 K = 5.4  
0.711 ?  
0.725 K = 7.8  
1.697 K = 3.4

E.P.Tomlinson, S.L.Ridgway, K.Gopalakrishnan, BAPS 28, 3, 012(1953); Verbal report.

$\gamma$  0.607 K/LM~15 s ce<sup>-</sup>  
R.E.Maerkar, R.D.Birkhoff, Phys. Rev. 89, 1159 (1953).

$\gamma$  (0.60)  $\tau < 2 \times 10^{-9}$   $\beta\gamma$   
T.C.Engelder, Phys. Rev. 90, 259(1953).

$\gamma$  (1.70) (E)1 99.8%  $\gamma\gamma(\theta)$   
 $\alpha = 2.6 \times 10^{-4}$   
(1.70 $\gamma$ ) (0.60 $\gamma$ ) ( $\theta$ )  $I = 3, 2, 0$   
I(2.3 level Te<sup>124</sup>) = 3-  
(2.08 $\gamma$ ) (0.60 $\gamma$ ) ( $\theta$ )  $I = 3, 2, 0$

F.R.Metzger, Phys. Rev. 90, 328(1953).

$\gamma$  (1.70) (E)1 99.8%  $\gamma\gamma(\theta)$   
(1.70 $\gamma$ ) (0.60 $\gamma$ ) ( $\theta$ )  $I = 3, 2, 0$

J.J.Kraushaar, M.Goldhaber, Phys. Rev. 89, 1081 (1953).

<sup>52</sup>Tc<sup>123</sup>  $\gamma$  (0.150)  $\tau = 1.9 \times 10^{-10}$   $e_K^-e_K^-$   
100<sup>d</sup> R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).

<sup>52</sup>Tc<sup>125</sup>  $\gamma$  (0.035)  $\tau = 1.6 \times 10^{-9}$   $e_L^-e_L^-$   
58<sup>d</sup> R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).

$\text{Te}^{125}$	$\gamma$	0.0355	$\alpha_K = 160$	pc
			K: L: M = 5.4 : 3.6 : 1.0	
		0.110	$\alpha_K = 11$	
J.G.Balfour, quoted by S.C.Curran, Physica 18, 1161(1952).				
$\text{I}^{126}$	$\beta^-$	72.5 †	0.87	I(28-Mev d); sl
		27.5 †	1.26	
	$\beta^+$	2.7 †	1.21	
	$\gamma$		sl ce <sup>-</sup> , pe <sup>-</sup> scin	
		0.390	$\alpha_K = 0.016$	K/LM ≥ 8 E2
		0.67		
		$\epsilon_K / (0.67\gamma) \sim 1.25^*$	$(0.39\gamma) / (0.67\gamma) \sim 1.0$	
		$(\sim 0.9\beta^-)$	$(0.39\gamma)$	$(K \times \text{ray}) (0.67\gamma)$
*From comparison with $\text{Cs}^{137}$ K x ray/ $\gamma$ value				
N.Marty, H.Langevin, P.Hubert, Compt. rend 236, 1153(1953).				
$\text{I}^{127}$	q	0.69	solid I <sub>2</sub> Mic	
	T	8.05 <sup>d</sup> ± 0.01	U(n,f)	
$\text{Xe}^{131}$	$\tau$	8.06 <sup>d</sup> ± 0.02	R.M.Bartholomew, E.Brown, R.C.Hawkins, W.F. Merritt, L.Yaffe, Can. J. Chem. 31, 120(1953).	
	$\gamma$	(0.637) $\alpha_K = 0.0040$	E2	s ce <sup>-</sup> , pe <sup>-</sup>
		(0.722) $\alpha_K = 0.0031$	E2	
	J.L.Wolfson, Can. J. Phys. 30, 715(1952).			
Mass assignment of 54 <sup>m</sup> activity confirmed from U(n,f) cumulative yield of 7.7% ( $\text{Xe}^{132}$ yield = 4.2%, $\text{Xe}^{134}$ yield = 8.2%; ms)				
L.Yaffe, A.E.Day, B.A.Greer, Can. J. Chem. 31, 48(1953).				
Xe	Neutron resonances (ev)	$E_n = 1.5$ ev to 2 kev		
	9.3			
	13.9	$\sigma_0 \Gamma^2 \sim 1000$		
	S.P.Harris, Phys. Rev. 89, 904A(1953).			
$\text{Xe}^{133}$	$\gamma$	(0.08)	$\alpha_K = 1.8$	K/LM = 8 M1
			$\tau = 8 \times 10^{-9}s$	$\beta^- e_K$
	R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).			
$\text{Xe}^{135}$	$\tau$	9.13 <sup>h</sup>	U(n,f) chem	
9.2h	F.Brown, L.Yaffe, Can. J. Chem. 31, 242(1953).			
	$\gamma$	(0.25)	$\tau = 2.8 \times 10^{-10}s$	$\beta^- e_K$
			K/LM = 5.6	
	R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).			
$\text{Xe}^{145}$	Existence of 0.8 <sup>s</sup> Xe activity in doubt Previously reported as p 1.8 <sup>h</sup> Ce <sup>145</sup> , q.v.			
9.1	A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267(1953).			

$\text{Cs}^{134}$	$\gamma$	0.202	0.663 s pe <sup>-</sup> , ce <sup>-</sup>	
55 79	2.3 <sup>y</sup>	0.475	0.797 K/L = 7.3	
		0.563	0.803	
		0.570	1.039	
		0.605	K/L = 6.4 1.168	
			1.368	
J.M.LeBlanc, W.H.Nester, D.W.Martin, M.K.Brice, J.M.Cork, Phys. Rev. 89, 907A(1953).				
	$\gamma$	0.602	K/LM = 6.6 s ce <sup>-</sup>	
		0.799	K/LM = 7.8	
R.E.Maerker, R.D.Birkhoff, Phys. Rev. 89, 1159(1953).				
$\text{Cs}^{137}$	$\tau$	33 <sup>y</sup>	U(n,f) chem ms	
55 82	Calc. from $\text{Cs}^{137}/\text{Cs}^{133}$ ratios measured between 4.2 and 5.4 years after fission			
		D.R.Wiles, B.W.Smith, R.Horsley, H.G.Thode, Can. J. Phys. 31, 419(1953).		
	$\beta^-$	0.512	$\Delta I = 2$ , yes shape sl	
		1.20	$\Delta I = 2$ , no	
C.D.Broyles, D.A.Thomas, S.K.Haynes, Phys. Rev. 89, 715(1953).				
	$\gamma$	0.663	K/LM = 4.52 s ce <sup>-</sup>	
R.E.Maerker, R.D.Birkhoff, Phys. Rev. 89, 1159(1953).				
$\text{Cs}^{138}$	$\tau$	32 <sup>m</sup>	U(n,f) chem	
55 83	$\beta^-$	3.40	F-K plot not linear sl	
	$\gamma$	33 <sup>t</sup>	sl ce, scin	
		43 <sup>t</sup>	scin	
		100 <sup>t</sup>	scin	
		(~3 $\beta^-$ X 1.44Y ?)		
		(1.44Y)(0.48Y ?)	(1.44Y)(0.98Y ?)	
L.M.Langer, R.B.Duffield, C.W.Stanley, Phys. Rev. 89, 907A(1953).				
$\text{Ba}^{133}$	$\gamma$	(0.012)	$\tau < 0.02^{4s}$	
56 77	39 <sup>h</sup>	M.Langevin, Compt. rend 236, 689(1953).		
	$\text{Ba}^{140}$	0.540	K/LM ~ 6 s ce <sup>-</sup>	
56 84	R.E.Maerker, R.D.Birkhoff, Phys. Rev. 89, 1159(1953).			
	$\tau$	40.2 <sup>h</sup>	La(pile n)	
57 83	R.M.Bartholomew, F.Brown, R.C.Hawkins, W.F.Merritt, L.Yaffe, Can. J. Chem. 31, 120(1953).			
	$\gamma$	0.488	K/LM = 3.7 s ce <sup>-</sup>	
R.E.Maerker, R.D.Birkhoff, Phys. Rev. 89, 1159(1953).				
$\text{Ce}$	No fission product Ce with $\theta^m < \tau < 13.9^m$ chem			
		A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267(1953).		
$\text{Ce}^{141}$	$\gamma$	(0.145)	$\tau < 2 \times 10^{-9}s$	
58 83			$\beta\gamma$	
	T.C.Engelder, Phys. Rev. 90, 259(1953).			

**Ce<sup>145</sup>** No 1.8<sup>h</sup>Ce activity U(n,f) chem  
 58 87 Previously reported activity due  
     to 2.0<sup>h</sup>Nd impurity?  
 A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267  
 (1953).

**Ce<sup>146</sup>**  $\tau$  13.9<sup>m</sup> d 24.4<sup>m</sup>Pr U(n,f) chem  
 58 88  $\beta^-$  ~0.9 a  
 $\gamma$  ~0.2 a  
 A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267  
 (1953).

**Pr<sup>141</sup>**  $\mu$  3.8 M  
 59 82 H-Lew, Phys. Rev. 89, 530(1953).

$\mu$  +3.9 S  
 Calculated from data of White, Phys. Rev.  
 34, 1397(1929)

P.Brix, Phys. Rev. 89, 1245(1953).

**Pr<sup>144</sup>**  $\gamma$  (0.895)  $\tau < 2 \times 10^{-9}$ <sup>s</sup>  $\beta\gamma$   
 59 85 T.C.Engelder, Phys. Rev. 90, 259(1953).

**Pr<sup>145</sup>** No 4.5<sup>h</sup>Pr activity U(n,f) chem  
 59 86 Previously reported activity due  
     to 3.7<sup>h</sup>La impurity?  
 A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267  
 (1953).

**Pr<sup>146</sup>**  $\tau$  24.4<sup>m</sup> d 13.9<sup>m</sup>Ce U(n,f) chem  
 59 87  $\beta^-$  3.8 a  
 A.A.Caretto, Jr., S.Katcoff, Phys. Rev. 89, 1267  
 (1953).

**Nd<sup>147</sup>**  $\gamma$  (0.092)  $\tau = 2.44 \times 10^{-9}$ <sup>s</sup>  
 60 87  $\alpha_K = 1.8$  K: L: M = 29:4:1  
 R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).

**Sm** Neutron resonances (ev)\*  $E_n = 0.1$ ev to 40ev  
 3.43\*\* 19  
 12 ? 22  
 15.2

\*Isotopic assignment uncertain  
 \*\*Not Sm 149, 152, or 154

V.L.Sailor, H.L.Foote, Jr., H.H.Landon, Phys.  
 Rev. 89, 904A(1953); priv. comm.

**Sm<sup>149</sup>** Neutron resonances (ev)  $E_n = 0.1$ ev to 40ev  
 62 87 0.094  
 0.87  
 4.95

V.L.Sailor, H.L.Foote, Jr., H.H.Landon, Phys.  
 Rev. 89, 904A(1953); priv. comm.

**Sm<sup>152</sup>** Neutron resonance (ev)  $E_n = 0.1$ ev to 40ev  
 62 90 8.20

V.L.Sailor, H.L.Foote, Jr., H.H.Landon, Phys.  
 Rev. 89, 904A(1953); priv. comm.

**Eu<sup>152</sup>**  $\tau_2$  12.4<sup>y</sup> ± 0.4 Eu(pile n)  
 63 89 Counted for 1.1 years with  $\beta$  electroscope  
 5.3<sup>y</sup>  
 E-E.Lockett, R-H.Thomas, Nucleonics 11, No. 3,  
 14(1953).

$\tau_2$  15.6<sup>y</sup> ± 1.5 Eu(pile n)  
 Counted for 200 days with 1c  
 J.Kastner, Can. J. Phys. 31, 169(1953).

**Eu<sup>152</sup>**  $\gamma$  1.40 s m pe<sup>-</sup>  
 63 L-Y.Shavtvalov, Zhur. Ekspptl' i Teoret. Fiz.  
 23, 611(1952).

**Gd<sup>148</sup>?**  $\tau$  > 35<sup>y</sup> Sm<sup>147</sup> (32-Mev  $\alpha$ ) Eu(32-Mev p);  
 64 84  $\alpha$  > 25% 3.2 ion chem yield; 1c  
 No 7<sup>h</sup> activity found Sm(30-Mev  $\alpha$ ) ion chem  
 (7.5<sup>h</sup>At from Bi impurity?)  
 \*Assuming  $\sigma$ (36-Mev  $\alpha$ , 3n) = 1

J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

**Gd<sup>149</sup>**  $\epsilon$  Sm<sup>147</sup> (31-Mev  $\alpha$ ) not Sm(19-Mev d),  
 64 84  $\alpha$  ~0.0007% 3.0 ion chem; 1c  
 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

**Gd<sup>150</sup>?**  $\alpha$  2.7 Eu(19-Mev d) chem; 1c  
 64 86 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

**Tb<sup>149</sup>**  $\tau$  4.1<sup>h</sup> Eu(80-Mev  $\alpha$ )  
 65 84  $\epsilon$  ? Gd(31-Mev p); ion chem  
 $\alpha$  3.95  
 No  $\beta^+$   
 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

**Tb<sup>151</sup>?**  $\tau$  19<sup>h</sup> Gd(100-Mev p) Eu(45-Mev  $\alpha$ )  
 65 86  $\alpha$  > 0.0004% 3.4 ion chem; 1c  
 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953); \*M-A.Roller, J.O.Ras-  
 mussen, ibid.

**Dy<sup>149</sup> Dy<sup>153</sup>**  $\tau$  19<sup>m</sup> Tb(100-Mev p)  
 66  $\alpha$  4.1 not Eu(120-Mev  $\alpha$ ); 1c  
 $\tau$  2.3<sup>h</sup> Tb(100-Mev p); ion chem  
 $\alpha$  3.6 Nd(~100-Mev C<sup>12</sup>); 1c  
 $\tau$  7<sup>m</sup> Tb(100-Mev p)  
 $\alpha$  4.2 Nd(~100-Mev C<sup>12</sup>); 1c  
 Not Eu(120-Mev  $\alpha$ )  
 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

**Ho?**  $\tau$  ~4<sup>m</sup> Dy(200-Mev p)  
 $\alpha$  4.2 Sm(100-Mev C<sup>12</sup>)? 1c  
 No Ho  $\alpha$  activity observed with  $\tau > 1^h$   
 Er(200-Mev p) Yb(250-Mev p); ion chem  
 J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiorso,  
 Phys. Rev. 89, 33(1953).

			$W^{187}$	$\gamma$	K/L	K/L
Er	No Er $\alpha$ activity observed with $\tau > 1^h$ Er(200-Mev p) Yb(250-Mev p); ion chem J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiors, Phys. Rev. 89, 33(1953).		$74_{\text{113}}$			
Tm	No Tm $\alpha$ activity observed with $\tau > 1^h$ Er(200-Mev p) Yb(250-Mev p); ion chem J.O.Rasmussen, Jr., S.G.Thompson, A.Ghiors, Phys. Rev. 89, 33(1953).					
Yb	Neutron resonances (ev) $E_n = 0.1$ ev to 40 ev 0.597 13.3 4.55 18.2 8.09 30 V.L.Sailor, H.L.Foote, Jr., H.H.London, Phys. Rev. 89, 904A(1953).					
$Lu^{176}$	$T_B^-$ $2.0 \times 10^{10} V$ $92 \beta^1/\text{sec/g Lu}^*$ $2.4 \times 10^{10} \gamma$ $\sim 0.4$ a $\gamma$ $100 \pm 0.20$ scin $100 \pm 0.32$ (0.32 $\gamma$ ) (0.20 $\gamma$ ) (0.4 $\beta$ ) ( $\gamma$ ) No 0.52 $\gamma$ (< 10%) 0.090 $\gamma$ not observed x ray/disintegration $\sim 0.35$ accounted for by $\gamma$ conversion J.R.Arnold, T.Sugihara, Phys. Rev. 90, 332(1953); *A.D.Suttle, Jr., ibid.		$75_{\text{110}}$	I $5/2$ $q(Re^{185})/q(Re^{187}) = 1.06$		Mic
$Lu^{177}$	(0.206 $\gamma$ ) (0.112 $\gamma$ ) $b = -0.20$ $I = 5/2, 7/2, 3/2$ (E)1, (E)2 T.Wiedling, Arkiv Fysik 6, 39(1953).		$75_{\text{112}}$	I $5/2$ $q(Re^{185})/q(Re^{187}) = 1.06$		Mic
$Hf^{181}$	$\gamma$ (0.48) $\tau = 1.04 \times 10^{-8} s$ (ce $^-$ ) ( $\gamma$ ) T.C.Engelder, Phys. Rev. 90, 259(1953).					
$W^{185}$	$\gamma$ (0.34) (0.48) $\tau = 1.06 \times 10^{-8} s$ $\gamma\gamma$ H. de Waard, Physica 18, 1151(1952). $\sim 10^{10} s$ level produced by Ta( $\gamma$ , $\gamma'$ ) $E_{\gamma'} \leq 6.5$ scin H.N.Brown, R.A.Becker, Phys. Rev. 90, 328(1953).		$75_{\text{113}}$	$18.7^m$ 0.06 $\alpha \sim 2$ D $18^h Re^*$	Re(slow n) a Szilard-Chalmers chem	pc
$W^{187}$	$\tau$ $23.85^h$ W(slow n) G.G.Eichholz, Phys. Rev. 89, 525(1953).					
	$\tau$ $24.0^h$ $W^{186}$ (pile n, $\gamma$ ) $\beta^-$ * 80% 0.622 20% 1.304		$18^h$	$\gamma$ 0.153 0.485 0.645 1.4 (0.65 $\gamma$ ) (1.4 $\gamma$ )	Re <sup>187</sup> (pile n) s ce $^-$ scin	sl

$^{76}_{\text{Os}}{}^{185}$	$\gamma$	0.163 0.234 0.645 0.879	$s ce^-$	$^{78}_{\text{Pt}}{}^{193}$ g.s.	$\tau_2$ $> 74^d$ or $< 1^h$ Measurements outside these limits obscured by $72^d$ Ir and $80^m$ Pt		
		J.-M. Cork, J.-M. LeBlanc, W.-H. Nester, D.-W. Martin, M.-K. Brice, Phys. Rev. 90, 444(1953).			J.-B. Swan, W.-M. Portnoy, R.-D. Hill, Phys. Rev. 90, 257(1953).		
$^{76}_{\text{Os}}{}^{193}$	$\gamma$	0.073 0.106 0.139 0.251 0.281 0.321	$L_1/L_{\text{II}} \sim 1$ $L/M \sim 3$ $K/L \sim 5$ $K/L \sim 10$ $K/L \sim 8$	$s ce^-$	$^{79}_{\text{Au}}{}^{193}$ $\tau$ $\alpha$	$4.3^m$ $5.1$	Pt(120-Mev p); chem ic
		J.-M. Cork, J.-M. LeBlanc, W.-H. Nester, D.-W. Martin, M.-K. Brice, Phys. Rev. 90, 444(1953).			J.-O. Rasmussen, Jr., S.-G. Thompson, A.-Ghiorso, Phys. Rev. 89, 33(1953).		
$^{77}_{\text{Ir}}{}^{192}$	$\beta^-$	16% 40% 44% No $0.84\beta^-$ ( $< 0.4\%$ ) $\gamma$	0.24 0.54 0.67 $K^*$ 0.137 0.202 0.207 0.296 0.309 0.317 0.401 0.420 0.440 0.468 0.488 0.590 0.605 0.613 0.880	$L^*$ $\sim 1.8$ $M^*$	$s$	$^{79}_{\text{Au}}{}^{195}$ $\gamma$ $30^s$	$d$ $38^h$ Hg; $sm \sqrt{2}$
			~0.65 4.3 18 15 34 ~0.1 ~0.1 ~0.05 7.7 0.50 0.45 1.4 0.58 4.4**	4.0 7.4 6.7 18 5.5		K.-Gopalakrishnan, A.-de-Shalit, J.-W.-Mihelich, Phys. Rev. 89, 908A(1953).	
		$*(ce^-/\beta) \times 10^{-3}$	$**(ce^-/\beta) \times 10^{-6}$				
		A.-A. Bashilov, N.-M. Anton'eva, B.-S. Dzhelepov, Izvest. Akad. Nauk Ser. Fiz. SSSR 16, 264(1952).					
$^{77}_{\text{Ir}}{}^{194}$	$\gamma$	100† 100† 1† (1.48y) (0.33y) (θ)	0.33 1.48 {1.8 {2.1 I = 2,2,0	scin	$^{79}_{\text{Au}}{}^{198}$ $\tau$	$2.697^d \pm 0.003$	Au(pile n) β electroscope
					Counted for 10 days		
					E.-E. Lockett, R.-H. Thomas, Nucleonics 11, No. 3, 14(1953).		
		J.-J. Kraushaar, M.-Goldhaber, Phys. Rev. 89, 1081 (1953).			$\gamma$	(0.68) (0.68y) (0.41y) (θ)	(E) 2 60% (M) 1 40% $\gamma\gamma(\theta)$ I = 2,2,0
						C.-D. Schrader, E.-B. Nelson, J.-A. Jacobs, Phys. Rev. 90, 159(1953).	
		No $\epsilon_K$ (<0.5%)					sl
		from absence of Pt Auger e <sup>-</sup>					
		C.-D. Broyles, D.-A. Thomas, S.-K. Haynes, Phys. Rev. 89, 715(1953).					
$^{78}_{\text{Pt}}{}^{191}$	$\tau$	3.2 <sup>d</sup>	Ir(10-Mev d) chem, not Pt(<22-Mev γ)		$^{80}_{\text{Hg}}{}^{193}$ $10^h$	0.039 0.102 0.032 0.120 0.258	Au(p) chem; $sm \sqrt{2} ce^-$ (Hg)
	$\gamma$	0.062 0.082 0.094 0.125	0.129 0.171 0.178 0.267	$s \pi ce^-$			$sm \sqrt{2} ce^-$ (Au)
		No 0.042γ	0.350 0.359 0.408 0.455				
		J.-B. Swan, W.-M. Portnoy, R.-D. Hill, Phys. Rev. 89, 907A; 90, 257(1953).	0.537				
$^{78}_{\text{Pt}}{}^{193}$	$\tau_1$	4.5 <sup>d</sup>	Ir(10-Mev d) chem Pt(<22-Mev γ)		$^{29}_{\text{Hg}}{}^{193}$ $\tau_2$	$27^h$	Au(p) chem
4.3 <sup>d</sup>	$\gamma$ IT	0.135	M4	$s \pi$			K.-Gopalakrishnan, A.-de-Shalit, J.-W.-Mihelich, Phys. Rev. 89, 908A(1953).
		K: L <sub>I</sub> : L <sub>II</sub> : M: N = 10: 12: 24: 13: 8					
		J.-B. Swan, W.-M. Portnoy, R.-D. Hill, Phys. Rev. 89, 907A; 90, 257(1953).					
					$^{80}_{\text{Hg}}{}^{203}$ $38^h$	$(0.28)$	$\tau < 2 \times 10^{-9}s$
						T.-C. Engelder, Phys. Rev. 90, 259(1953).	βγ

**Tl<sup>204</sup>**  $\tau$   $2.71^y \pm 0.05$  Tl(pile n)  
81 123 Counted for 8 months  $\beta$  electroscope  
E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3,  
14(1953).

**Tl<sup>206</sup>**  $\tau$   $4.19^m \pm 0.02$  Tl(pile n)  
81 125 Counted for 25 half-lives  $\beta$  electroscope  
B.W.Sargent, L.Yaffe, A.P.Gray, Can. J. Phys.  
31, 235(1953).

**Tl<sup>207</sup>**  $\tau$   $4.79^m \pm 0.02$  Bi<sup>211</sup> recoil  
81 126 Counted for 25 half-lives  $\beta$  electroscope  
B.W.Sargent, L.Yaffe, A.P.Gray, Can. J. Phys.  
31, 235(1953).

**Tl<sup>208</sup>**  $(0.58y) (2.62y)$  polarization-direction  
81 127  $I = 4^+, 2^+, 0^+$   
J.J.Kraushaar, M.Goldhaber, Phys. Rev. 89, 1081  
(1953).

**Pb<sup>200</sup>**  $\gamma$   $0.139$  Tl(80-Mev d) chem  
82 118  $0.320$   $s\pi/2 ce^-$   
G.D.O'Kelley, UCRL-1243(1951).

**Pb<sup>203</sup>**  $\gamma$   $0.153$  Tl(80-Mev d) chem  
82 121  $0.269$  K/L = 2.3  $s\pi/2 ce^-$   
 $0.424$   
G.D.O'Kelley, UCRL-1243(1951).

**Pb<sup>205</sup>** Levels  $Pb^{206}$  (d,t)  $E_d = 14$  a pc  
82 123  
0.3  
0.8  
1.8  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Pb<sup>206</sup>** Levels  $Pb^{207}$  (d,t)  $E_d = 14$  a pc  
82 124  
0.9 2.2  
1.4 3.0  
1.7  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Pb<sup>207</sup>** Levels  $Pb^{206}$  (d,p)  $Pb^{208}$  (d,t)  
82 125  
0.6 0.6  
1.0 1.0  
2.8 1.6  
3.6 2.3  
4.4  
4.7  
5.3  $E_d = 14$  a pc  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Pb<sup>208</sup>** Levels  $Pb^{207}$  (d,p)  $E_d = 14$  a pc  
82 126  
3.4 5.4  
3.6 6.1  
5.1  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Pb<sup>209</sup>** Levels  $Pb^{208}$  (d,p)  $E_d = 14$  a pc  
82 127  
0.8 2.0  
1.6 2.5  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Pb<sup>210</sup>**  $\beta^-$  0.015 pc  
82 128  
No 0.0078y (Cu x ray ?)  
A.A.Jaffe, S.G.Cohen, Phys. Rev. 89, 454(1953).

$\beta^-$  0.024 pc  
F-K plot linear to 8.5 kev  
E.Huster, Naturwiss. 40, 197(1953).

$\gamma$  (0.047) L : M : N = 100 : 23 : 6 EA  
 $ce^-$  0.0110 not assigned  
No  $ce^-$  (0.014-0.030) < 1% of  $ce^-$  (0.0487y)  
Y.Kobayashi, G.Miyamoto, J. Phys. Soc. Japan 8,  
135(1953); 273(1953).

$(L \times ray) / (0.047y) = 6.3$  pc  
Peaks seen ascribed to nuclear  $\gamma$ 's of  
16.1, 24, 30.7, 37.0, 41.5, 62.5 kev  
P.E.Damon, R.R.Edwards, Phys. Rev. 90, 280(1953).

**Pb<sup>212</sup>**  $\gamma$  0.23863 s  
82 130  
 $H\rho(F) = 1388.56 \pm 0.21$   
H determined (2-20 kev) with  $e^-$  accelerated  
through known potential.  
D.I.Meyer, F.H.Schmidt, Phys. Rev. 89, 908A  
(1953).

$\gamma$  (0.258)  $\tau < 2 \times 10^{-11}s$   $\beta e_K^-$   
R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).

**Pb<sup>214</sup>**  $\beta^-$  0.35? s  $\beta e^-$   
82 132  
33<sup>+</sup> 0.67  
100<sup>+</sup> ~0.73  
 $\gamma$  4.5\* 0.241 s  $ce^-$   
4.8\* 0.294  
3.5\* 0.350  
[0.67 $\beta$ ] [ $e_K$  (0.35y)]  
[0.73 $\beta$ ] [ $e_K$  (0.29y)]  
\*  $ce^-$  per 100  $\beta^-$   
E.E.Berioich, Izvest. Akad. Nauk Ser. Fiz. SSSR  
16, 314(1952).

**Bi<sup>208</sup>** Bi(d,t)  $E_d = 14$  a pc  
83 125 Q values -1.17  
-1.8  
-2.2  
J.A.Harvey, Can. J. Phys. 31, 278(1953).

**Bi<sup>209</sup>**  $\mu$  4.0400  $Bi(NO_3)_3, D_2O$ ; I  
83 126  $\nu(Bi^{209})/\nu(D) = 1.04684 \pm 0.00005$   
Y.Ting, D.Williams, Phys. Rev. 89, 595(1953).

<b>Bi<sup>210</sup></b>	$\tau_2$	$4.989^d \pm 0.013$	Bi(pile n)	<b>Po<sup>206</sup></b>	$\alpha$	5%	$d 2.3^h Rn^{210}$
83 127 4.9 <sup>d</sup>	Counted for 33 days	$\beta^-$ electroscope	E.E.Lockett, R.H.Thomas, Nucleonics 11, No. 3, 14(1953).	84 122			F.F.Momyer, UCRL-2060(1953).
No 0.080Y ( $< 0.02\%$ of $\beta^-$ 's)	scin			<b>Po<sup>210</sup></b>	$\tau$	$138.39^d \pm 0.14$	calorimeter
D.G.E.Martin, G.Parry, Phil. Mag. 44, 344(1953).				84 126	Observed for 200 days		
Continuous $\gamma$ spectrum	scin			D.C.Ginnings, A.F.Ball, D.T.Vier, J. Research Natl. Bur. Standards 50, 75(1953); J. Franklin Inst. 255, 241(1953).			
$\gamma(E_\gamma > 0.09) / \beta^- = 0.00084$				<b>Po<sup>212</sup></b>	$\tau$	$2.9 \times 10^{-7}s$	$\beta^-$
P.Bolgiano, L.Madansky, F.Rasetti, Phys. Rev. 89, 679(1953).				84 128	T		
Q value	Bi(d,p)	$E_d = 15$	scin	84 134	$\alpha$	5.996	s
1.94					G.Bastin-Scoffler, J. Sant'ana-Dionisio, Compt. rend. 236, 1016(1953).		
No higher energy p group ( $< 3\%$ of $Q = 1.94$ group)				<b>At<sup>211</sup></b>	$\alpha$	5.862	
but believed not g.s. Q				85 126	R.W.Hoff, F.Asaro, quoted by F.F.Momyer, UCRL-2060(1953).		
N.S.Wall, BAPS 28, 3, UA2(1953).				<b>At<sup>219</sup></b>	$\tau$	0.9 <sup>m</sup>	$d 21^m Fr^{223}$
Q values	Bi(d,p)	$E_d = 14$	a pc	85 134	$\alpha$	6.27	chem
1.94 -0.3					$\alpha/\beta^- = 30$		ic
0.30 -0.8					E.K.Hyde, A.Ghiorso, Phys. Rev. 90, 267(1953).		
J.A.Harvey, Can. J. Phys. 31, 278(1953).				<b>Rn<sup>208</sup></b>	$\tau$	$23^m$	$d 4^h Po^{204}$
<b>Bi<sup>212</sup></b>	$\alpha$	6.051*	s	86 122	$\epsilon$	$\sim 80\%$	Th(340-Mev p)
83 129		6.090			$\alpha$	$\sim 20\%$	
*Value of 6.046 (Nature 187, 682) in error						6.138	s
E.R.Collins, C.D.Mckenzie, C.A.Ramm, Proc. Roy. Soc. 216A, 219(1953).					F.F.Momyer, UCRL-2060(1953).		
$\gamma$	(0.040)	$\tau < 7 \times 10^{-11}s$	$\alpha e_L$	<b>Rn<sup>209</sup></b>	$\tau$	$30^m$	$d 5.7^h At^{209}$
R.L.Graham, R.E.Bell, Can. J. Phys. 31, 377(1953).				86 123	$\epsilon$	$\sim 85\%$	Th(340-Mev p)
<b>Bi<sup>214</sup></b>	$\beta^-$	81% ~1.55.	Ra <sup>226</sup> source $\alpha\beta\gamma$		$\alpha$	$\sim 15\%$	
83 131		< 10% (2.56)	a			6.04	s
		19% (3.17)	a		F.F.Momyer, UCRL-2060(1953).		
$E_{dis} = 3.17$				<b>Rn<sup>210</sup></b>	$\tau$	$2.7^h$	$d 9^d Po^{206}$
A.H.Wapstra, Physica 18, 1247(1952).				86 124	$\epsilon$	$< 5\%$	Th(340-Mev p)
$\gamma$	0.605	1.379	$s\pi$ Cpt line		$\alpha$	> 95%	
	0.699*	1.504*	1.832*			6.036	s
	0.770	1.627**	2.116**		F.F.Momyer, UCRL-2060(1953).		
	0.907	1.679** (2.193)					
	(1.120)	1.727**	2.42**				
	1.247	(1.761)					
( ) Used as standards				<b>Rn<sup>211</sup></b>	$\tau$	$16^h$	Th(340-Mev p)
* $ce_K^-$ seen by Ellis but assigned otherwise				86 125	$\epsilon$	74%	
** $ce_K^-$ seen by Ellis but not assigned					$\alpha$	17%	
M.Mladjenović, A.Hedgran, Physica 18, 1242(1952).						9%	
$\gamma$	1.1205	$s\pi ce_K^-$				5.778	s
	1.4158					5.847	
$H_p = 4939.8 \pm 0.8$ , 5874.4 $\pm 0.8$ gauss cm					$\gamma$	0.07	scin
G.Lindström, A.Hedgran, D.E.Alburger, Phys. Rev. 89, 1303(1953).						0.15	
<b>Bi<sup>215</sup></b>	$\tau$	$8^m$	$d 0.9^m At^{219}$	<b>Rn<sup>212</sup></b>	$\alpha$	6.262	$Th(340-\text{Mev p})$
83 132			$d 2^{ms} Po^{215}$	86 126	F.F.Momyer, UCRL-2060(1953).		s
E.K.Hyde, A.Ghiorso, Phys. Rev. 90, 267(1953).				<b>Rn<sup>220</sup></b>	$\alpha$	6.278	
				86 134	G.Bastin-Scoffler, J.Sant'ana-Dionisio, Compt. rend. 236, 1016(1953).		s

<sup>86</sup> Rn <sup>221</sup> <sup>135</sup>	$\tau$	<sup>25<sup>m</sup></sup>	Th(110-Mev p)	<sup>91</sup> Pa <sup>231</sup> <sup>140</sup>	0.357 0.383	K : L = 10: 2 K = 5
	$\beta^-$	~80%				Unassigned $\text{ce}^-$
	$\alpha$	~20%				0.125, 0.135, 0.170
			F.F. Momyer, UCRL-2060(1953).			P.Falk-Valranc, M.Riou, J. Phys. Radium 14, 66 (1953); P. Falk-Valranc, Compt. rend. 235, 796 (1952).
<sup>86</sup> Rn <sup>222</sup> <sup>136</sup>	$\alpha$	<sup>5.482</sup>	s	<sup>U</sup>	Neutron resonances (ev)	$E_n = 3.7$ to 800 ev
			G.Bastin-Scoffler, J.Sant'ana-Dionisio, Compt. rend. 236, 1016(1953).		6.6 20 38	$\sigma_0 = 5000$ $\Gamma = 0.05$ $\sigma_0 \Gamma^2 = 4.5$ $\sigma_0 \Gamma^2 = 6.5$
<sup>87</sup> Fr <sup>212</sup> <sup>125</sup>	$\alpha$	24% <sup>6.339</sup> 39% <sup>6.387</sup> 37% <sup>6.409</sup>	s			E.Hellstrand, R.Persson, Arkiv Fysik 6, 57(1953).
			E.K.Hyde, F.Asaro, quoted by F.F.Momyer, UCRL-2060(1953).			
<sup>87</sup> Fr <sup>223</sup> <sup>136</sup>	$\alpha/\beta^-$	$\sim 4 \times 10^{-5}$		<sup>92</sup> U <sup>237</sup> <sup>145</sup>	$\tau$	<sup>6.75<sup>d</sup></sup>
			E.K.Hyde, A.Ghiorso, Phys. Rev. 90, 267(1953).		$\beta^-$	< 20% (0.080) > 80% 0.25
<sup>88</sup> Ra <sup>213</sup> <sup>125</sup>	$\tau$	<sup>2.7<sup>m</sup></sup>	D 30 <sup>m</sup> Rn <sup>209</sup> Pb(C <sup>12</sup> )		$\gamma$	0.027
	$\alpha$	6.90	ic			0.043 0.059 0.165 21 <sup>†</sup> 0.207 0.269 2.5 <sup>†</sup> 0.334 0.370 0.430
			F.F.Momyer, UCRL-2060(1953).			(0.21 $\gamma$ )(0.027 $\gamma$ ) (0.21 $\gamma$ )(0.08 $\gamma$ ) (0.21 $\gamma$ )(0.17 $\gamma$ ) (0.25 $\beta$ ) (0.21 $\gamma$ ) No (0.33 $\gamma$ ) ( $\gamma$ ) No 0.51 $\beta$ (< 0.1%) No photon with $E_\gamma > 0.34$ (< 10% of 0.33 $\gamma$ )
<sup>88</sup> Ra <sup>224</sup> <sup>136</sup>	$\alpha$	<sup>5.679</sup>	s			F.Wagner, Jr., M.S.Freedman, D.W.Engelkemair, J.R.Huizenga, Phys. Rev. 89, 502(1953).
			G.Bastin-Scoffler, J.Sant'ana-Dionisio, Compt. rend. 236, 1016(1953).			
<sup>88</sup> Ra <sup>226</sup> <sup>138</sup>	$\alpha$	<sup>4.777 ± 0.004</sup>	s	<sup>93</sup> Np <sup>234</sup> <sup>141</sup>	$\gamma$	<sup>0.177</sup>
		Based on $E_\alpha(\text{Po}) = 5.299$				<sup>0.442</sup>
			G.Bastin-Scoffler, J.Sant'ana-Dionisio, Compt. rend. 236, 1016(1953).			<sup>0.803</sup>
<sup>89</sup> Ac <sup>228</sup> <sup>139</sup>	$\beta^-$	<sup>2.18</sup>	$s\pi\sqrt{2}$			1.42
	$\gamma$	<sup>0.0568</sup>	$\tau > 0.01^s$			G.D.O'Kelley, UCRL-1243(1951).
			$E_{dis} = 2.24$			
			At least 6 lower energy $\beta$ spectra observed			
			J.Kyles, C.G.Campbell, W.J. Henderson, quoted by N.Feather, Physica 18, 1241(1952).			
<sup>90</sup> Th <sup>228</sup> <sup>138</sup>	$\alpha$	(0.083 $\gamma$ ) ( $\theta$ )	does not agree with I=0, I, 0	<sup>94</sup> Pu <sup>238</sup> <sup>144</sup>	$\tau$	<sup>89.6<sup>y</sup></sup>
		$\tau(0.083\gamma) < 10^{-8}s$	Source Th(OH) <sub>4</sub>			
		No (0.086 $\gamma$ ) ( $\alpha$ )	No $\gamma\gamma$			A.H.Jaffey, J.Lerner, ANL-4411(1950).
			J.Battey, L.Madansky, F.Rasetti, Phys. Rev. 89, 1821(1953).			
<sup>91</sup> Pa <sup>231</sup> <sup>140</sup>	$\gamma$	0.0273 $\alpha < 10$ 0.0336 0.0380 0.0569 0.0635 0.0823	E1 a ce-, ppl $L_I + L_{II} \approx L_{III}$ E2 $L_I \approx M_I$ Rel. intensity of ce-		$\gamma$	0.0451
		0.102 0.198 0.259 0.301 0.331	$L_{II} : L_{III} : M = 2 : 2 : 2$ $K : L = 2 : 5$ $K : L = 10 : 5$ $K : L : M = 100 : 20 : 7$ $\alpha_K \sim 1.6$ M1 $K : L : M = 50 : 10 : 1$ $\alpha_K \sim 1.6$ M1			VW 0.048 ?
			Pu from long n irradiation of Am <sup>241</sup>			G.D.O'Kelley, UCRL-1243(1951).
				<sup>94</sup> Pu <sup>241</sup> <sup>147</sup>	$\tau_{\beta^-}$	<sup>13.0<sup>y</sup></sup>
			From Am <sup>241</sup> present 2.39 years after initial purification			
			D.R.Mackenzie, M.Lounsbury, A.W.Boyd, Phys. Rev. 90, 327(1953).			
				<sup>94</sup> Pu <sup>243</sup> <sup>149</sup>	$\tau$	<sup>4.98<sup>h</sup></sup>
			Pu <sup>242</sup> (pile n) ion chem		$\beta^-$	12% (~0.37) 35% 0.468 53% 0.57
					$\gamma$	0.085 $\alpha_L \leq 0.7$ ~0.1 $\alpha_L > 10$
			(0.47 $\beta$ )(0.085 $\gamma$ ) (0.085 $\gamma$ ) (~0.1 $\gamma$ ) (0.085 $\gamma$ ) (L X rays)			
			No (0.57 $\beta^-$ ) (0.085 $\gamma$ ) No (0.57 $\beta^-$ ) (L X rays)			
			D.W.Engelkemair, P.R.Fields, J.R.Huizenga, Phys. Rev. 90, 6(1953).			

**Am<sup>241</sup>**  
95 146 I 5/2 S

Large q indicated

M.Fred, F.S.Thomkins, Phys. Rev. 89, 318(1953).

$\gamma$  0.059  $\text{sm} \sqrt{2} \text{ ce}^-$   
 $[\epsilon_L(0.059\gamma)]/\alpha = 0.28$

G.D.O'Kelley, UCRL-1243(1951).

No 0.0334 $\gamma$ , 0.0380 $\gamma$  (<0.1% of 0.0597) $\gamma$  pc  
 Suggest lines seen\* at 0.014, 0.019, 0.022  
 due to Am x rays, those at 0.033, 0.038 to  
 La x rays

J.O.Newton, B.Rose, Phys. Rev. 89, 1157(1953).  
 \*C.I.Browne, UCRL-1764(1952); F.Asaro, et al.,  
 Phys. Rev. 87, 277(1952).

**Am<sup>242</sup>**  
95 147  $\beta^-$  70% 0.628  $\text{sm} \sqrt{2}$   
 $\epsilon$  15%  $\text{Am}^{241}$ (pile n) chem  
 $\gamma$  I.T. 15% 0.035  $\alpha = 0.25$   $\text{sm} \sqrt{2}$  Am ce<sup>-</sup>  
 0.038  $\alpha = 0.25$  Pu ce<sup>-</sup>  
 0.053  $\alpha = 0.67$  Cm ce<sup>-</sup>

L<sub>III</sub>/L<sub>II</sub> x ray ratios:  $\frac{\text{Am}}{4.9}$   $\frac{\text{Pu}}{1.3}$   $\frac{\text{Cm}}{1.0}$  cryst

No  $\gamma$  with  $E_\gamma > 0.06$  a

G.D.O'Kelley, UCRL-1243(1951).

**100<sup>y</sup>**  $\beta^-$  0.593  $\text{Am}^{241}$ (pile n) chem  
 $\gamma$  0.038  $\text{sm} \sqrt{2}$  Pu ce<sup>-</sup>  
 0.053 Cm ce<sup>-</sup>

G.D.O'Kelley, UCRL-1243(1951).

**Cm<sup>242</sup>**  
96 146  $\gamma$  0.043  $\alpha_L = 0.8$   $\text{sm} \sqrt{2} \text{ ce}^-$   
 G.D.O'Kelley, UCRL-1243(1951).

## NEUTRON CROSS SECTIONS

### Neutron Cross Sections

Reaction	$\sigma$ Type	Value	Energy	Ref.
H(n)	$\sigma_t$	2.525	2.532	53f2
	graph		3-13	53n1
	$\sigma_t$	1.690	4.75	53h3
	$\sigma_t$	0.057	126	53t2
Be(n)	$\sigma_t$	6.04	1ev-5kev	52h5
	graph		3-13	53n1
C(n)	$\sigma_t$	graph	3-13	53n1
	$\sigma_t$	graph	30-139	53t2
N(n)	$\sigma_t$	graph	1.7-4	52j2
N <sup>14</sup> (n,2n)	$\sigma(10^m N)$	5.7 mb	14.5	53p1
O(n)	$\sigma_{el}$	0.7	14.1	53c3
O(n,<14.1n)	$\sigma_{in}$	0.5	14.1	53c3
O(n)	$\sigma_t$	graph	3-13	53n1
	$\sigma_t$	1.6	14.1	53c3
O <sup>16</sup> (n,p)	$\sigma(7.3^m N)$	49 mb	14.5	53p1

### Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
F <sup>19</sup> (n,2n)	$\sigma(1.9^h F)$	61 mb	14.5	53p1
F <sup>19</sup> (n,p)	$\sigma(30^s)$	130 mb	14.5	53p1
Na(n)	$\sigma_t$	2.98	1ev-1kev	52h5
	graph		1ev-10kev	52h5
Na <sup>23</sup> (n,p)	$\sigma(40^s \text{Ne})$	34 mb	14.5	53p1
Na <sup>23</sup> (n, $\gamma$ )	$\sigma(15.0^h \text{Na})$	0.53	th	53p2
Mg <sup>24</sup> (n,p)	$\sigma(15.0^h \text{Na})$	190 mb	14.5	53p1
Mg <sup>25</sup> (n,p)	$\sigma(62^s \text{Na})$	45 mb	14.5	53p1
Al(n)	$\sigma_t$	graph	3-13	53n1
	$\sigma_t$	graph	30-139	53t2
Al <sup>27</sup> (n, $\alpha$ )	$\sigma(15.0^h \text{Na})$	79 mb	14.5	53p1
Al <sup>27</sup> (n,p)	$\sigma(9.5^m \text{Mg})$	52 mb	14.5	53p1
Si(n)	$\sigma_t$	graph	3-13	53n1
Si <sup>28</sup> (n,p)	$\sigma(2.4^m \text{Al})$	220 mb	14.5	53p1
Si <sup>29</sup> (n,p)	$\sigma(6.6^m \text{Al})$	100 mb	14.5	53p1
Si <sup>30</sup> (n, $\alpha$ )	$\sigma(9.5^m \text{Mg})$	46 mb	14.5	53p1
P(n)	$\sigma_t$	2.22	14	53a1
P <sup>31</sup> (n, $\alpha$ )	$\sigma(2.4^m \text{Al})$	0.15	14.5	53p1
P <sup>31</sup> (n,p)	$\sigma(2.6^h \text{Si})$	0.064	14.5	53p1
S(n)	$\sigma_t$	graph	3-13	53n1
	$\sigma_t$	2.06	14	53a1
S <sup>32</sup> (n,p)	$\sigma(14.3^d \text{P})$	0.37	14.5	53p1
S <sup>34</sup> (n, $\alpha$ )	$\sigma(26^h \text{Si})$	0.14	14.5	53p1
S <sup>34</sup> (n,p)	$\sigma(12.4^s \text{P})$	0.085	14.5	53p1
Cl <sup>35</sup> (n, $\alpha$ )	$\sigma(14.3^d \text{P})$	0.19	14.5	53p1
Cl <sup>35</sup> (n,2n)	$\sigma(33^m \text{Cl})$	0.0035	14.5	53p1
Cl <sup>37</sup> (n, $\alpha$ )	$\sigma(12.4^s \text{P})$	0.052	14.5	53p1
Cl <sup>37</sup> (n,p)	$\sigma(5.0^m \text{S})$	0.033	14.5	53p1
K <sup>39</sup> (n,2n)	$\sigma(7.5^m \text{K})$	0.010	14.5	53p1
K <sup>41</sup> (n, $\alpha$ )	$\sigma(38^m \text{Cl})$	0.031	14.5	53p1
K <sup>41</sup> (n,p)	$\sigma(1.8^h \text{A})$	0.081	14.5	53p1
Sc(n)	$\sigma_a$	23	th	53l1
	$\sigma_a$	23	th	52p3
Sc <sup>45</sup> (n, $\gamma$ )	$\sigma(85^d \text{Sc})$	22	th	53l2
Ti <sup>48</sup> (n,p)	$\sigma(1.8^d \text{Sc})$	0.093	14.5	53p1
V(n)	$\sigma_t$	graph	0.02-5ev	53b4
V <sup>51</sup> (n, $\alpha$ )	$\sigma(1.8^d \text{Sc})$	0.029	14.5	53p1
V <sup>51</sup> (n,p)	$\sigma(8^h \text{Ti})$	0.027	14.5	53p1
Cr <sup>52</sup> (n,p)	$\sigma(3.7^m \text{V})$	0.078	14.5	53p1
Mn <sup>55</sup> (n, $\alpha$ )	$\sigma(3.7^m \text{V})$	0.052	14.5	53p1
Mn <sup>55</sup> (n, $\gamma$ )	$\sigma(2.6^h \text{Mn})$	12.7	th	53b2
Fe(n,n')	$\sigma(\text{all } \gamma's)$	4.6	14	53b2
	$\sigma(\sim 6.5 \text{MeV } \gamma's) \sim 0.5$		14	53b6
	$\sigma(\sim 2.5 \text{MeV } \gamma's) \sim 2.4$		14	53b6
Fe(n)	$\sigma_t$	graph	3-13	53n1

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
Fe <sup>56</sup> (n, p)	$\sigma(2.6^h\text{Mn})$	0.097	14.5	53p1
Fe <sup>56</sup> (n, n')	$\sigma(0.85\gamma)$	~0.4	1.23	53r1
Co(n)	$\sigma_t$	graph	0.1 - 3	53w2
Co <sup>59</sup> (n, $\alpha$ )	$\sigma(2.6^h\text{Mn})$	0.039	14.5	53p1
Ni <sup>58</sup> (n, 2n)	$\sigma(36^h\text{Ni})$	0.041	14.5	53p1
Ni <sup>61</sup> (n, p)	$\sigma(1.7^h\text{Co})$	0.18	14.5	53p1
Cu(n)	$\sigma_t$	graph	3 - 13	53n1
	$\sigma_t$	3.09	14	53a1
	$\sigma_t$	table	30 - 153	53t2
	$\sigma_t$	1.19	400	53n2
Cu <sup>63</sup> (n, 2n)	$\sigma(10^h\text{Cu})$	0.48	14.5	53p1
	$\sigma(10^m\text{Cu})$	graph	13 - 27	53b6
Cu <sup>65</sup> (n, 2n)	$\sigma(12.9^h\text{Cu})$	1.10	14.5	53p1
Zn <sup>64</sup> (n, 2n)	$\sigma(38^m\text{Zn})$	0.22	14.5	53p1
Zn <sup>64</sup> (n, p)	$\sigma(12.9^h\text{Cu})$	0.39	14.5	53p1
Zn <sup>66</sup> (n, p)	$\sigma(5^m\text{Cu})$	0.10	14.5	53p1
Ga(n)	$\sigma_t$	graph	0.1 - 3	53w2
Ga <sup>69</sup> (n, $\alpha$ )	$\sigma(5^m\text{Cu})$	0.10	14.5	53p1
Ga <sup>69</sup> (n, 2n)	$\sigma(68^m\text{Ga})$	0.55	14.5	53p1
Ga <sup>69</sup> (n, p)	$\sigma(14^h\text{Zn})$	0.024	14.5	53p1
Ga <sup>71</sup> (n, 2n)	$\sigma(20^m\text{Ga})$	0.70	14.5	53p1
Ge(n)	$\sigma_t$	graph	0.4 - 3.5	52j2
Ge <sup>70</sup> (n, 2n)	$\sigma(40^h\text{Ge})$	0.67	14.5	53p1
Ge <sup>70</sup> (n, p)	$\sigma(20^m\text{Ga})$	0.13	14.5	53p1
Ge <sup>72</sup> (n, p)	$\sigma(14^h\text{Oa})$	0.065	14.5	53p1
Ge <sup>73</sup> (n, p)	$\sigma(5.0^h\text{Ga})$	0.14	14.5	53p1
Ge <sup>74</sup> (n, $\alpha$ )	$\sigma(2.2^m\text{Zn})$	0.015	14.5	53p1
Ge <sup>76</sup> (n, 2n)	$\sigma(82^m\text{Ge})$	1.80	14.5	53p1
As <sup>75</sup> (n, $\alpha$ )	$\sigma(14^h\text{Ga})$	0.012	14.5	53p1
As <sup>75</sup> (n, 2n)	$\sigma(17^d\text{As})$	0.54	14.5	53p1
As <sup>75</sup> (n, p)	$\sigma(82^m\text{Ge})$	0.012	14.5	53p1
Se(n)	$\sigma_t$	graph	0.4 - 3.5	52j2
	$\sigma_t$	graph	0.1 - 3	53w2
Se <sup>77</sup> (n, p)	$\sigma(40^h\text{As})$	0.045	14.5	53p1
Se <sup>80</sup> (n, $\alpha$ )	$\sigma(59^m\text{Se})$	0.038	14.5	53p1
Se <sup>82</sup> (n, 2n)	$\sigma(59^m\text{Se})$	1.5	14.5	53p1
Br <sup>79</sup> (n, 2n)	$\sigma(6.4^m\text{Br})$	1.10	14.5	53p1
Br <sup>81</sup> (n, $\alpha$ )	$\sigma(90^m\text{As})$	0.10	14.5	53p1
Br <sup>81</sup> (n, 2n)	$\sigma(4.4^h\text{Br})$	0.83	14.5	53p1
Rb <sup>87</sup> (n, $\alpha$ )	$\sigma(33^m\text{Br})$	0.039	14.5	53p1
Sr <sup>84</sup> (n, $\gamma$ )	$\sigma(65^d\text{Sr})$	1.2	th	53l2
Sr <sup>88</sup> (n, $\alpha$ )	$\sigma(4.4^h\text{Kr})$	0.064	14.5	53p1
Sr <sup>88</sup> (n, p)	$\sigma(17.8^m\text{Rb})$	0.018	14.5	53p1
Y <sup>89</sup> (n, $\alpha$ )	$(19^d\text{Rb})$	0.070	14.5	53p1
Zr(n)	$\sigma_t$	graph	3 - 13	53n1
Zr <sup>90</sup> (n, $\alpha$ )	$\sigma(2.8^h\text{Sr})$	0.2	14.5	53p1

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
Zr <sup>90</sup> (n, 2n)	$\sigma(4.5^m\text{Zr})$	0.08	14.5	53p1
Zr <sup>90</sup> (n, p)	$\sigma(61^h\text{Y})$	0.25	14.5	53p1
Zr <sup>94</sup> (n, p)	$\sigma(16^m\text{Y})$	0.01	14.5	53p1
Mo <sup>92</sup> (n, 2n)	$\sigma(15.5^m + 75^s\text{Mo})$	0.19	14.5	53p1
	$\sigma(15.5^m\text{Mo})$	graph	13 - 27	53b6
Mo <sup>97</sup> (n, p)	$\sigma(76^m\text{Nb})$	0.1	14.5	53p1
Mo <sup>100</sup> (n, 2n)	$\sigma(86^h\text{Mo})$	3.8	14.5	53p1
Rh(n)	$\sigma_s$	4.1	0.15 ev	53b4
Pd <sup>104</sup> (n, p)	$\sigma(4.3^m + 44^s\text{Rh})$	0.13	14.5	53p1
Pd <sup>105</sup> (n, p)	$\sigma(36^h\text{Rh})$	0.7	14.5	53p1
Pd <sup>110</sup> (n, $\alpha$ )	$\sigma(4^m\text{Ru})$	0.014	14.5	53p1
Pd <sup>110</sup> (n, 2n)	$\sigma(13^h\text{Pd})$	1.9	14.5	53p1
Ag <sup>107</sup> (n, 2n)	$\sigma(24.5^m\text{Ag})$	0.5	14.5	53p1
Ag <sup>109</sup> (n, 2n)	$\sigma(2.3^m\text{Ag})$	0.3	14.5	53p1
Cd(n, n')	$\sigma(49^m\text{Cd})$	0.21	1.27	53f3
	graph	0.4 - 1.3	53f3	
Cd(n)	$\sigma_s/\sigma_a$	graph	0.025 - 0.4 ev	53b4
	$\sigma_t$	graph	0.175 ev	53b4
	$\sigma_t$	graph	0.1 - 3	53w2
	$\sigma_t$	graph	0.4 - 3.5	52j2
	$\sigma_t$	table	37 - 153	53t2
	$\sigma_t$	1.84	400	53n2
Cd <sup>110</sup> (n, $\gamma$ )	$\sigma(49^m\text{Cd})$	<0.001	0.2 - 0.4	53f3
Sb <sup>121</sup> (n, 2n)	$\sigma(16.6^m\text{Sb})$	0.75	14.5	53p1
Sb <sup>123</sup> (n, 2n)	$\sigma(2.6^d\text{Sb})$	1.2	14.5	53p1
Te(n)	$\sigma_t$	graph	0.1 - 3	53w2
Te <sup>128</sup> (n, 2n)	$\sigma(9.3^h\text{Te})$	0.78	14.5	53p1
Te <sup>130</sup> (n, 2n)	$\sigma(72^m + 32^d\text{Te})$	0.60	14.5	53p1
I <sup>127</sup> (n, $\alpha$ )	$\sigma(21^m\text{Sb})$	0.018	14.5	53p1
I <sup>127</sup> (n, 2n)	$\sigma(13.0^d\text{I})$	1.1	14.5	53p1
	graph	12 - 18	53m1	
I <sup>127</sup> (n, p)	$\sigma(9.3^h\text{Te})$	0.23	14.5	53p1
I <sup>127</sup> (n, $\gamma$ )	$\sigma(25^m\text{I})$	graph	0.25 - 1.6	53m4
Ba <sup>138</sup> (n, p)	$\sigma(33^m\text{Cs})$	0.006	14.5	53p1
Ba <sup>138</sup> (n, $\gamma$ )	$\sigma(58^m\text{Ba})$	0.053	~25 kev	53k4
La <sup>139</sup> (n, p)	$\sigma(85^m\text{Ba})$	0.006	14.5	53p1

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
$\text{Ce}^{140}(n,\alpha)$	$\sigma(2.6^m\text{Ba})$	0.012	14.5	53p1
$\text{Pr}^{141}(n,2n)$	$\sigma(3.6^m\text{Pr})$	2.1	14.5	53p1
$\text{Sm}^{152}(n,\alpha)$	$\sigma(1.7^h\text{Nd})$	0.009	14.5	53p1
$\text{Sm}^{154}(n,2n)$	$\sigma(47^h\text{Sm})$	0.22	14.5	53p1
$\text{Sm}^{203}(n)$	$\sigma_s/\sigma_a$ Single level indicated	graph	0.025 - 0.16 ev	53b4
$\text{Eu}^{203}(n)$	$\sigma_s/\sigma_a$	graph	0.025 - 0.16 ev	53b4
$\text{Gd}^{160}(n,2n)$	$\sigma(18.0^h\text{Gd})$	1.5	14.5	53p1
$\text{Gd}^{203}(n)$	$\sigma_s/\sigma_a$ Two levels indicated	graph	0.025 - 0.16 ev	53b4
$\text{Dy}^{203}(n)$	$\sigma_s/\sigma_a$	graph	0.025 - 0.13 ev	53b4
$\text{Hf}(n)$	$\sigma_{el}$	4.7	1.0	53w3
$\text{Ta}^{181}(n,2n)$	$\sigma(8.0^h\text{Ta})$	0.9	14.5	53p1
$\text{W}^{186}(n,\gamma)$	$\sigma(24^h\text{W})$	0.12	25 kev	53k4
$\text{Pt}(n)$	$\sigma_t$	graph	0.1 - 3	53w2
$\text{Pt}^{198}(n,2n)$	$\sigma(18^h\text{Pt})$	3	14.5	53p1
$\text{Au}(n)$	$\sigma_t$	graph	0.1 - 3	53w2
$\sigma_t$		5.1	14	53a1
$\text{Au}^{197}(n,2n)$	$\sigma(5.6^d\text{Au})$	1.7	14.5	53p1
$\text{Hg}(n)$	$\sigma_t$	graph	0.1 - 3	53w2
$\sigma_t$	graph	0.4 - 3.5	52j2	
$\sigma_t$	5.3	14	53a1	
$\text{Tl}^{205}(n,p)$	$\sigma(5.6^m\text{Hg})$	0.003	14.5	53p1
$\text{Pb}(n)$	$\sigma_{el}$	4.6	1.0	53w3
$\text{Pb}(n,n')$	$\sigma(\sim 3.5 \text{ Mev } \gamma's)$	~0.3	14	53b5
$\sigma(\sim 2.5 \text{ Mev } \gamma's)$	~4	14	53b5	
$\text{Pb}(n)$	$\sigma_t$	graph	3 - 13	53n1
$\sigma_t$	5.8	14	53a1	
$\sigma_t$	4.22	55	53r2	
$\sigma_t$	4.87	85	53r2	
$\sigma_t$	table	37 - 153	53t2	
$\sigma_t$	2.88	400	53n2	
$\text{Pb}^{208}(n,p)$	$\sigma(3.1^m\text{Tl})$	0.001	14.5	53p1
$\text{Bi}(n)$	$\sigma_{el}$	4.8	1.0	53w3
$\sigma_t$	graph	3 - 13	53n1	
$\sigma_t$	5.4	14	53a1	
$\text{Bi}^{209}(n,\alpha)$	$\sigma(4.2^m\text{Tl})$	0.001	14.5	53p1
$\text{Ac}^{227}(n)$	$\sigma_a$	500	th	52p3
$\text{Th}(n)$	$\sigma_t$	graph	0.1 - 3	53w2
$\sigma_t$	3.23	400	53n2	

## Neutron Cross Sections - Continued

Reaction	$\sigma$ Type	Value	Energy	Ref.
$\text{Th}^{230}(n)$	$\sigma_a$	30 - 60	pile	49h1
$\text{Pa}^{230}(n)$	$\sigma_s$	~1500	pile	47g1
$\text{Pa}^{231}(n, \gamma\beta^-)$	$\sigma(70^h\text{U})$	290	pile	53e3
$\text{Pa}^{232}(n,\gamma)$	$\sigma(27.4^d\text{Pa})$	~40	pile	53e3
$\text{U}(n)$	$\sigma_t$	graph	3.7 - 800 ev	53h5
	$\sigma_t$	graph	3 - 13	53n1
	$\sigma_t$	3.26	400	53n2
$\text{U}^{232}(n)$	$\sigma_a$	< 500	pile	53e1
$\text{U}^{232}(n,f)$	$\sigma_f$	~80	th	53e1
47gl	A.Ghiorsa, W.H.Studler, E.K.Hyde, priv. comm. Value assuming $\epsilon/\beta^-(\text{Pa}^{230}) = 11.5$ .			
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## GROUND STATE Q'S

Reaction	Standard	Value	Method	Ref.
$\text{Li}^6(\text{p},\alpha)\text{He}^3$	absolute	+ 4.023 ± 0.003	s	53c1
$\text{Li}^6(\text{d},\alpha)\text{He}^4$	absolute	+ 22.396 ± 0.012	s	53c1
$\text{Li}^6(\text{d},\text{p})\text{Li}^7$	absolute	+ 5.028 ± 0.003	s	53c1
$\text{Li}^7(\text{p},\alpha)\text{He}^4$	absolute	+ 17.352 ± 0.009	s	53c1
$\text{Be}^9(\text{p},\alpha)\text{Li}^8$	absolute	+ 2.126 ± 0.003	s	53c1
$\text{Be}^9(\text{d},\alpha)\text{Li}^7$	absolute	+ 7.153 ± 0.004	s	53c1
$\text{Be}^9(\text{p},\text{d})\text{Be}^8$	absolute	+ 0.560 ± 0.003	s	53c1
$\text{Be}^9(\text{d},\text{t})\text{Be}^8$		+ 4.60 ± 0.03	ppl	52c2
$\text{B}^{10}(\text{n},\alpha)\text{Li}^7$	$\text{Po}^{212}$ $\alpha$	+ 2.781 ± 0.025	pc	52h7
$\text{B}^{10}(\text{d},\alpha)\text{Be}^8$	$\text{Bi}^{212}$ $\alpha$ $\text{Po}^{212}$ $\alpha$	+ 17.91 ± 0.08	ic	53t3
$\text{B}^{11}(\text{p},\alpha)\text{Be}^8$	absolute	+ 8.589 ± 0.005	s	53c1
$\text{N}^{14}(\text{d},\text{n})\text{O}^{15}$		+ 5.15 ± 0.16	ppl	53e2
$\text{N}^{14}(\text{a},\text{p})\text{O}^{17}$		- 1.16	ppl	53h4
$\text{N}^{15}(\text{p},\alpha)\text{C}^{12}$	absolute	+ 4.962 ± 0.004	s	53c1
$\text{Na}^{23}(\text{p},\alpha)\text{Ne}^{20}$	$\text{Li}^7(\text{p},\text{n})$	+ 2.379 ± 0.003	EA	53d1
$\text{Mg}^{24}(\text{p},\gamma)\text{Al}^{25}$	F(p, $\alpha$ )	+ 2.32 ± 0.10	scin	53c2
$\text{Mg}^{24}(\text{d},\text{n})\text{Al}^{25}$		+ 0.07 ± 0.06	ppl	53g2
$\text{Mg}^{26}(\text{p},\gamma)\text{Al}^{27}$	F(p, $\alpha$ )	+ 8.3 ± 0.4	scin	53c2
$\text{Al}^{27}(\text{p},\alpha)\text{Mg}^{24}$	$\text{Li}^7(\text{p},\text{n})$	+ 1.594 ± 0.002	EA	53d1
$\text{Al}^{27}(\text{p},\text{n})\text{Si}^{27}$	$\text{F}^{19}(\text{p},\alpha\gamma)$	- 5.61 ± 0.01	thresh	53k1
$\text{S}^{32}(\text{d},\text{n})\text{Cl}^{33}$		+ 0.25 ± 0.07	ppl	53m2
$\text{S}^{32}(\text{a},\text{p})\text{Cl}^{35}$		- 2.02 ± 0.11	ppl	52f2
Mass ( $\text{S}^{32}$ )/Mass ( $\text{S}^{34}$ )		1.06242	Mic	53b3
$\text{Cl}^{35}(\text{n},\alpha)\text{P}^{32}$		+ 1.07 ± 0.16	ic	52f2
$\text{Sc}^{45}(\text{n},\gamma)\text{Sc}^{46}$	absolute	+ 8.85 ± 0.08	pair s	53b1
$\text{Ti}^{47}(\text{n},\gamma)\text{Ti}^{48}$	absolute	+ 9.39 + 2.31 ? pair s	53k2	
$\text{Ti}^{48}(\text{n},\gamma)\text{Ti}^{49}$	absolute	+ 6.76 + 1.36 ? pair s	53k2	
$\text{Ti}^{49}(\text{n},\gamma)\text{Ti}^{50}$	absolute	+ 9.19 + 1.58 ? pair s	53k2	
$\text{V}^{51}(\text{n},\gamma)\text{V}^{52}$	absolute	+ 7.305 ± 0.007	pair s	53b1
$\text{Cr}^{52}(\text{d},\text{p})\text{Cr}^{53}$		+ 5.70	s	53m1
$\text{Cr}^{52}(\text{n},\gamma)\text{Cr}^{53}$	absolute	+ 7.929 ± 0.008	s	53k2
$\text{Cr}^{53}(\text{n},\gamma)\text{Cr}^{54}$	absolute	+ 9.716 ± 0.008	s	53k2
$\text{Mn}^{55}(\text{n},\gamma)\text{Mn}^{56}$	absolute	+ 7.261 ± 0.006	pair s	53b1

## Ground State Q's - Continued

Reaction	Standard	Value	Method	Ref.
$\text{Fe}^{54}(\text{n},\gamma)\text{Fe}^{55}$	absolute	+ 9.298 ± 0.007	pair s	53k2
$\text{Fe}^{56}(\text{n},\gamma)\text{Fe}^{57}$	absolute	+ 7.639 ± 0.004 (+0, 0.014, or 0.13)	pair s	53k2
$\text{Fe}^{57}(\text{n},\gamma)\text{Fe}^{58}$	absolute	+ 10.16 ± 0.04	pair s	53k2
$\text{Co}^{59}(\text{n},\gamma)\text{Co}^{60}$	absolute	+ 7.486 ± 0.009	pair s	53b1
$\text{Ni}^{58}(\text{d},\text{p})\text{Ni}^{59}$		+ 6.77	ppl	53m1
$\text{Ni}^{58}(\text{n},\gamma)\text{Ni}^{59}$	absolute	+ 8.997 ± 0.005	pair s	53k2
$\text{Ni}^{60}(\text{n},\gamma)\text{Ni}^{61}$	absolute	+ 8.532 ± 0.008	pair s	53k2
$\text{Cu}^{63}(\text{n},\gamma)\text{Cu}^{64}$	absolute	+ 7.914 ± 0.004	pair s	53b1
$\text{Cu}^{65}(\text{n},\gamma)\text{Cu}^{66}$	absolute	+ 7.634 ± 0.006?	pair s	53b1
		See $\text{Cu}^{66}$		
$\text{Zn}^{65}(\text{n},\gamma)\text{Zn}^{66}$	absolute	+ 7.876 ± 0.007	pair s	53k2
$\text{Zn}^{67}(\text{n},\gamma)\text{Zn}^{68}$	absolute	+ 9.51 ± 0.03?	pair s	53k2
$\text{Sr}^{88}(\text{d},\text{p})\text{Sr}^{89}$		+ 4.33 ± 0.10	s	53m1
$\text{Mo}^{92}(\gamma,\text{n})\text{Mo}^{91}$	--	- 13.1 ± 0.1	thresh	53k3
$\text{Mo}^{92}(\text{n},\text{n})\text{Mo}^{91}$	--	- 12.34	thresh	53b6
$\text{Pb}^{206}(\text{d},\text{p})\text{Pb}^{205}$	$\text{Al}^{27}(\text{d},\text{p})$	- 1.8 ± 0.1	range	53h6
$\text{Pb}^{206}(\text{d},\text{p})\text{Pb}^{207}$	$\text{Al}^{27}(\text{d},\text{p})$	+ 4.48 ± 0.05	range	53h6
$\text{Pb}^{207}(\text{d},\text{p})\text{Pb}^{206}$	$\text{Al}^{27}(\text{d},\text{p})$	- 0.42 ± 0.05	range	53h6
$\text{Pb}^{207}(\text{d},\text{p})\text{Pb}^{208}$	$\text{Al}^{27}(\text{d},\text{p})$	+ 5.14 ± 0.05	range	53h6
$\text{Pb}^{208}(\text{d},\text{t})\text{Pb}^{207}$	$\text{Al}^{27}(\text{d},\text{p})$	- 1.10 ± 0.05	range	53h6
$\text{Pb}^{208}(\text{d},\text{p})\text{Pb}^{209}$	$\text{Al}^{27}(\text{d},\text{p})$	+ 1.65 ± 0.05	range	53h6
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## PACKING FRACTION DIFFERENCES

 $\Delta f$ , in Units  $10^{-4}$  amu

Doublet	$\Delta f$	Ref.
H <sub>2</sub> - D	+ 7.746 ± 0.004	5301
He <sup>4</sup> - D <sub>2</sub>	-64.01 ± 0.02	5301
B <sup>10</sup> - Ne <sup>20</sup>	+16.722 ± 0.008	5301
B <sup>10</sup> H - B <sup>11</sup>	+10.41 ± 0.01	5301
B <sup>10</sup> D - C <sup>12</sup>	+22.51 ± 0.02	5301
B <sup>10</sup> F <sup>19</sup> - C <sup>13</sup> O <sup>16</sup>	+ 4.500 ± 0.005	5301
B <sup>10</sup> HF <sup>19</sup> - B <sup>11</sup> F <sup>19</sup>	+ 3.817 ± 0.005	5301
B <sup>11</sup> - Ne <sup>22</sup>	+12.382 ± 0.007	5301
B <sup>11</sup> H - C <sup>12</sup>	+14.262 ± 0.005	5301
B <sup>11</sup> F <sup>19</sup> - Si <sup>30</sup>	+11.316 ± 0.007	5301
C <sup>12</sup> - D <sub>3</sub>	+70.50 ± 0.02	5301
C <sup>12</sup> H <sub>4</sub> - O <sup>16</sup>	+22.759 ± 0.005	5301
C <sup>12</sup> H <sub>4</sub> - C <sup>12</sup> O <sup>16</sup>	+13.008 ± 0.003	5301
C <sup>12</sup> C <sup>13</sup> H - C <sup>12</sup> H <sub>3</sub>	- 1.661 ± 0.004	5301
C <sup>13</sup> O <sup>16</sup> - Si <sup>29</sup>	+ 7.517 ± 0.006	5301
C <sup>13</sup> O <sup>16</sup> - B <sup>10</sup> F <sup>19</sup>	- 4.500 ± 0.005	5301
N <sup>14</sup> - C <sup>12</sup> H <sub>2</sub>	- 8.989 ± 0.004	5301
N <sup>14</sup> - C <sup>12</sup> H <sub>4</sub>	- 8.986 ± 0.004	5301
N <sup>14</sup> - C <sup>12</sup> O <sup>16</sup>	+ 4.019 ± 0.003	5301
N <sup>15</sup> - C <sup>12</sup> H <sub>3</sub>	-15.585 ± 0.004	5301
H <sub>2</sub> O <sup>18</sup> - D <sub>2</sub> O <sup>16</sup>	- 4.15 ± 0.01	5301
B <sup>10</sup> F <sup>19</sup> - C <sup>13</sup> O <sup>16</sup>	+ 4.500 ± 0.005	5301
B <sup>11</sup> F <sup>19</sup> - Si <sup>30</sup>	+11.316 ± 0.007	5301
Ne <sup>20</sup> - B <sup>10</sup>	-16.722 ± 0.008	5301
Ne <sup>20</sup> - D <sub>2</sub> O <sup>16</sup>	-15.355 ± 0.008	5301
Ne <sup>22</sup> - B <sup>11</sup>	-12.382 ± 0.007	5301
Al <sup>27</sup> - C <sup>12</sup> H <sub>3</sub>	-15.561 ± 0.007	5301
Si <sup>28</sup> - C <sup>12</sup> O <sup>16</sup>	- 6.435 ± 0.005	5301
Si <sup>29</sup> - C <sup>13</sup> O <sup>16</sup>	- 7.517 ± 0.006	5301
Si <sup>30</sup> - B <sup>11</sup> F <sup>19</sup>	-11.316 ± 0.007	5301
P <sup>31</sup> H - S <sup>32</sup>	+ 2.969 ± 0.003	5302
P <sup>31</sup> H <sub>2</sub> - S <sup>32</sup> H	+ 2.876 ± 0.004	5302
P <sup>31</sup> H - O <sup>16</sup> <sub>2</sub>	- 2.577 ± 0.004	5302
S <sup>32</sup> - P <sup>31</sup> H	- 2.969 ± 0.003	5302
S <sup>32</sup> H <sub>2</sub> - P <sup>31</sup> H <sub>2</sub>	- 2.876 ± 0.004	5302
S <sup>32</sup> - O <sup>16</sup> <sub>2</sub>	- 5.539 ± 0.003	5301
S <sup>32</sup> H <sub>2</sub> - S <sup>34</sup>	+ 5.837 ± 0.006	5301

Packing Fraction Differences,  $\Delta f$ , In Units  $10^{-4}$  amu  
(continued)

Doublet	$\Delta f$	Ref.
S <sup>32</sup> O <sup>16</sup> - C <sup>12</sup> H <sub>4</sub>	- 6.900 ± 0.005	5301
S <sup>33</sup> H <sub>2</sub> - S <sup>34</sup> H	+ 3.250 ± 0.009	5301
S <sup>34</sup> H <sub>2</sub> - C <sup>12</sup> <sub>3</sub>	- 4.596 ± 0.008	5301
HCl <sup>35</sup> - C <sup>12</sup> <sub>3</sub>	- 6.479 ± 0.003	5301
Cl <sup>37</sup> - C <sup>12</sup> H <sub>2</sub>	-11.352 ± 0.004	5301
HCl <sup>37</sup> - C <sup>12</sup> H <sub>2</sub>	-11.053 ± 0.004	5301
A <sup>40</sup> - D <sub>2</sub> O <sup>16</sup>	-20.959 ± 0.007	5301
A <sup>40</sup> - C <sup>12</sup> H <sub>4</sub>	-17.234 ± 0.007	5301
Zr <sup>92</sup> - W <sup>184</sup>	- 7.59 ± 0.02	53g1
Zr <sup>94</sup> - Os <sup>188</sup>	- 7.59 ± 0.01	53g1
Zr <sup>96</sup> - Os <sup>192</sup>	- 7.48 ± 0.02	53g1
Mo <sup>92</sup> - W <sup>184</sup>	- 7.44 ± 0.02	53g1
Mo <sup>94</sup> - Os <sup>188</sup>	- 7.72 ± 0.02	53g1
Mo <sup>96</sup> - Os <sup>192</sup>	- 7.86 ± 0.01	53g1
Ru <sup>96</sup> - Os <sup>192</sup>	- 7.55 ± 0.02	53g1
Ru <sup>102</sup> - Pb <sup>204</sup>	- 8.02 ± 0.03	52h7
Ru <sup>104</sup> - Pb <sup>208</sup>	- 7.96 ± 0.01	52h7
Rh <sup>103</sup> - Pb <sup>206</sup>	- 7.94 ± 0.01	52h7
Pd <sup>102</sup> - Pb <sup>204</sup>	- 7.94 ± 0.04	52h7
Pd <sup>104</sup> - Pb <sup>208</sup>	- 8.05 ± 0.01	52h7
W <sup>184</sup> - Zr <sup>92</sup>	+ 7.59 ± 0.02	53g1
W <sup>184</sup> - Mo <sup>92</sup>	+ 7.44 ± 0.02	53g1
Os <sup>188</sup> - Zr <sup>94</sup>	+ 7.59 ± 0.01	53g1
Os <sup>188</sup> - Mo <sup>94</sup>	+ 7.72 ± 0.02	53g1
Os <sup>192</sup> - Zr <sup>96</sup>	+ 7.48 ± 0.02	53g1
Os <sup>192</sup> - Mo <sup>96</sup>	+ 7.86 ± 0.01	53g1
Os <sup>192</sup> - Ru <sup>96</sup>	+ 7.55 ± 0.02	53g1
Pb <sup>204</sup> - Ru <sup>102</sup>	+ 8.02 ± 0.03	52h7
Pb <sup>204</sup> - Pd <sup>102</sup>	+ 7.94 ± 0.04	52h7
Pb <sup>206</sup> - Rh <sup>103</sup>	+ 7.94 ± 0.01	52h7
Pb <sup>208</sup> - Ru <sup>104</sup>	+ 7.96 ± 0.01	52h7
Pb <sup>208</sup> - Pd <sup>104</sup>	+ 8.05 ± 0.01	52h7

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